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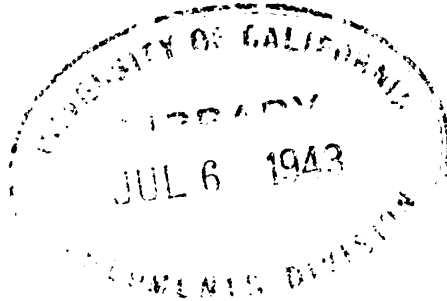
TM 5-271

U.S. WAR DEPARTMENT

TECHNICAL MANUAL

LIGHT STREAM-CROSSING EQUIPAGE

April 10, 1943



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LIGHT STREAM-CROSSING EQUIPAGE TM 5:211



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CHAPTER 1

GENERAL

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1. **Technical data.**—*a.* This manual supplies technical information covering the construction, use, and maintenance of the following types of stream-crossing equipment:

- (1) Assault boats M1 and M2.
- (2) Infantry support raft and expedient assault boat bridge.
- (3) Footbridge M1938.
- (4) Pneumatic reconnaissance boat and 6-ton pneumatic float.
- (5) Ferry set.

b. Technical Manuals covering other stream-crossing equipage are TM 5-272, TM 5-273, TM 5-274 (when printed), and TM 5-275 (when printed).

2. Tactical data.—a. Tactical considerations in stream crossings are covered in FM-6.

b. A forced stream crossing is divided into three phases as follows:

(1) *First phase*.—The crossing of the first infantry troops by means of assault boats. Storm boats or transport aircraft may be used to supplement the assault boats.

(2) *Second phase*.—Construction of infantry support rafts to carry combat vehicles and weapons carriers to the far shore. Some of the assault boats continue in operation. Whenever practicable a foot-bridge is constructed during this phase. In some instances expedient assault boat bridges may be constructed of infantry support raft equipage before ponton bridges are built.

(3) *Third phase*.—Rafts may be continued in operation. Ponton bridges are constructed after direct artillery fire and all small-arms fire have been eliminated from bridge sites.

CHAPTER 2

ASSAULT BOAT

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3. Purpose and use of equipage.—Assault boats are light, easily transported craft used to carry the leading elements of the assault in a forced stream crossing. M2 assault boats are also used in construction of the infantry support raft and the expedient assault boat bridge.

4. Assignment of equipage.—Assault boats are issued to engineer units as follows:

	Single assault boats	Included in raft equipage	Total
Light ponton company.....	70	72	142
Engineer combat battalion or engineer squadron.....	14	--	14

5. Description of equipage.—*a. Design features.*—(1) The assault boat M2 (figs. 1 and 2) is a scow type plywood boat with a square stern, flat bottom, and slightly tapered bow. Each boat is equipped

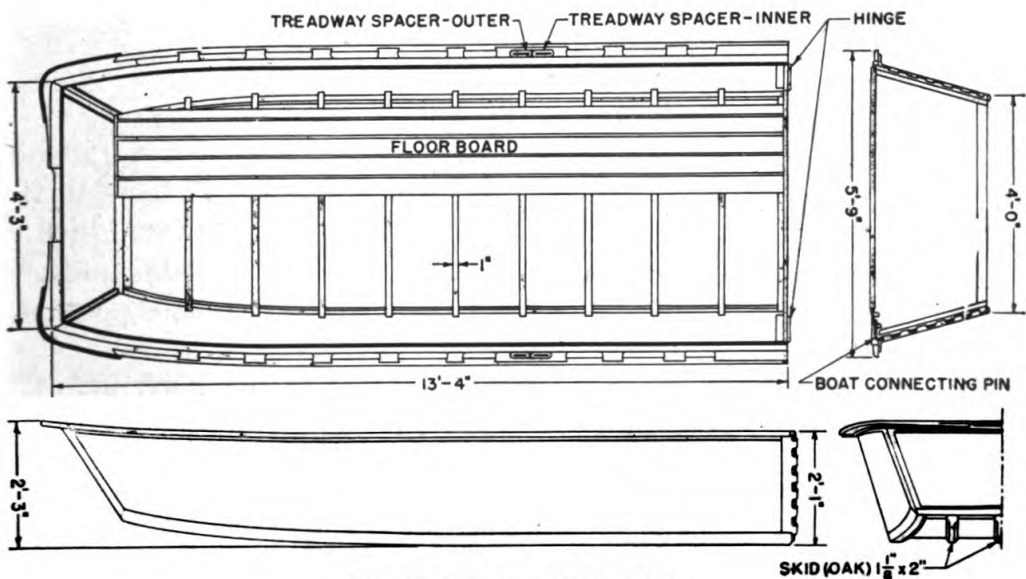


FIGURE 1.—Assault boat M2.

with two hinge connections and one boat-connecting pin, so that two boats can be coupled together stern-to-stern to form an assault boat ponton. Two treadway spacers, to space the plywood treadways, are located in each gunwale of the assault boats and are used when the boats are part of a raft or bridge.

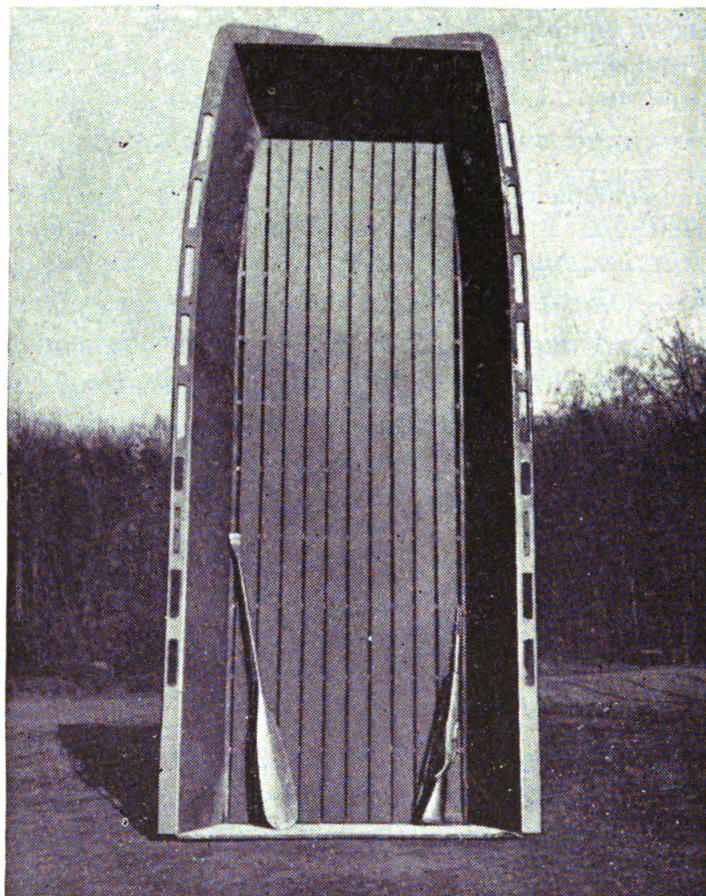


FIGURE 2.—Interior view of assault boat M2.

(2) The assault boat M2 has the following specifications:

Maximum width	5 feet 9 inches.
Over-all length	13 feet 4 inches.
Depth	2 feet 1 inch.
Weight (approximate)	410 pounds.
Displacement with a freeboard of 4 inches	5,300 pounds.
Displacement with a freeboard of 8 inches (approximate)	4,000 pounds.

(3) The sides of the assault boat are $\frac{7}{16}$ -inch mahogany plywood, the bottom is $\frac{3}{8}$ -inch fir plywood, and the transom is $\frac{3}{4}$ -inch fir plywood. The corner edges of the bottom, sides, and ends of the boat are bound with brass angle-strips which are fastened to the boat with

screws and rivets. The inside of the bottom is covered with a flooring of oak slats attached to the frames. The strip skids, fixed to the bottom for protection during loading and transport, are made of oak. The boats are painted olive drab.



FIGURE 3.—Assault boat being paddled by three-man engineer crew.



FIGURE 4.—Assault boat carrying 12 infantrymen and three-man engineer crew.

b. Capacity.—(1) A three-man crew is needed to operate the assault boat M2. (See fig. 3.) The boat will carry safely any one of the following loads of combat-equipped infantrymen and weapons *in addition to* the three-man engineer crew:

(a) Rifle squad (twelve men) with individual weapons and combat equipment.

(b) Two light machine-gun squads (ten men) with two caliber .30 light machine guns and 20 boxes of ammunition.

(c) Heavy machine-gun squad (seven men) with caliber .30 heavy machine gun and 13 boxes of ammunition.



FIGURE 5.—Assault boat carrying 7-man heavy machine-gun squad, three-man engineer crew, heavy machine gun caliber .30, and 13 boxes of ammunition.



FIGURE 6.—Assault boat carrying seven-man 81-mm mortar squad, three-man engineer crew, 81-mm mortar, and 50 rounds of ammunition.

(d) Browning machine-gun squad (seven men) with caliber .50 machine gun and four boxes of ammunition.

(e) Two 60-mm mortar squads (ten men) with two 60-mm mortars and 72 rounds of ammunition.

(f) 81-mm mortar squad (seven men) with 81-mm mortar and 50 rounds of ammunition.

(g) Infantry communication platoon wire section (eight men) with complete equipment.

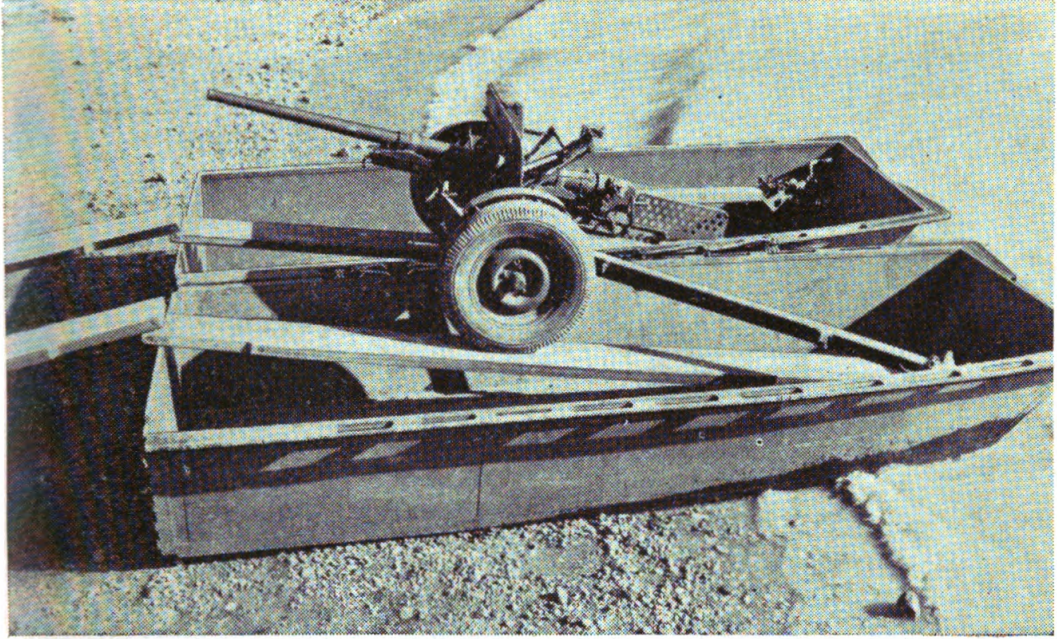


FIGURE 7.—Assault boats being loaded with 37-mm antitank gun.



FIGURE 8.—Assault boats carrying five-man antitank gun crew, three-man engineer crew, 37-mm antitank gun, and 100 rounds of ammunition.

(2) Two assault boats lashed together are best used to carry the 37-mm antitank gun with its five-man squad, an engineer crew of at least three men, and at least 100 rounds of ammunition.

6. Carrying.—Ten to twelve combat-equipped soldiers are required to carry the boat, special weapons, equipment, and ammunition. The boat is carried inverted until a point 100 to 200 yards from the stream is reached; then the boat is turned over, carried upright to the water's edge, and launched.

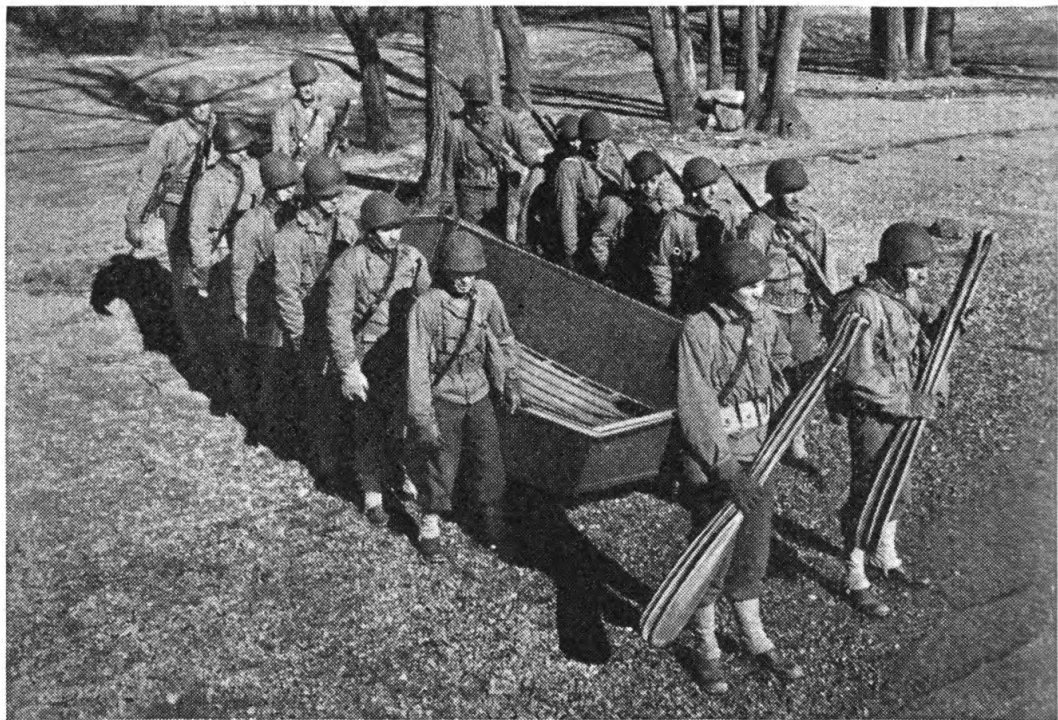


FIGURE 9.—Assault boat carried upright by twelve infantrymen.

7. Paddling.—*a. Three-man engineer crew.*—The engineer in charge of the boat kneels at the stern and steers. The other two engineer crew members kneel at either side of the bow and paddle.

b. Passengers.—Six passengers also paddle.

8. Transportation of equipment.—The boats are nested for transportation. The boats may be carried on 2½-ton trucks or on two-wheel trailers.

9. Care of equipment.—*a. Handling.*—(1) To save weight the assault boats are less rugged than heavier types of small boats in ordinary use and must be handled with care.

(2) The treadway spacers break easily. Care must be exercised to avoid striking them with a treadway.

b. Repairs.—(1) Major repairs to the bottom or sides of the assault boat may be made by applying plywood and metal patches to the outside of the hull. The following method is satisfactory for effecting permanent repairs: Enlarge the hole to an opening of square or rectangular shape. Cut a piece of plywood to fit tightly in the enlarged

opening, and cut two pieces of aluminum or other metal, each piece just large enough to cover the enlarged opening and provide space for nailing. Fit the plywood into the opening, place one metal patch on the outside and another on the inside, and nail them into place, clinching the nails to prevent loosening.

(2) Small holes may be repaired with patches of sheet metal, preferably copper, applied in a coating of white lead on the outside and fastened with shingle nails clinched on the inside. Bullet holes may be plugged temporarily with pegs, wads of paper, adhesive tape, or putty.

(3) Broken frames should be replaced.

c. Maintenance.—Issue olive-drab paint is satisfactory since the boats are in the water for relatively short periods of time. The boat has few seams and as these are well protected by construction and by metal strips, recalking is seldom required. When recalking is necessary, a standard marine calking compound such as canoe glue is used; calking cotton should never be used in these boats. It is not necessary to soak the boat before using it.

10. Storage.—The boats should be stored under cover, protected from sun and weather. Before being placed in storage for protracted periods they should be dried, cleaned, inspected, and, if necessary, repaired and painted. If space is limited, boats may be nested in stacks of not more than 12. The bottom of the lowermost boat in each stack must be chocked carefully so as to support it and allow free circulation of air.

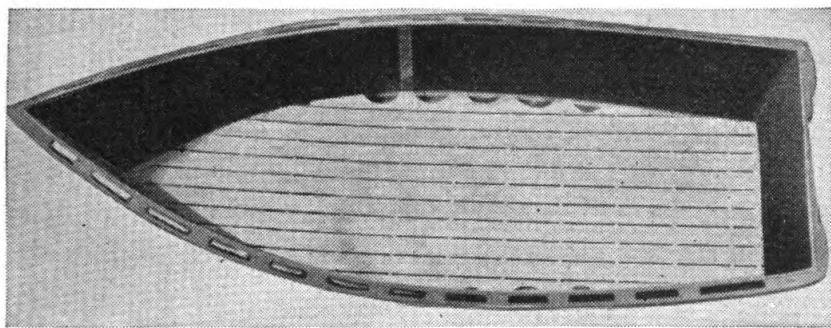


FIGURE 10.—Interior view of assault boat M1.

11. Assault boat M1.—The assault boat M1 (fig. 10) has been superseded by the assault boat M2. Since a considerable number of these boats are still in use, this boat is described briefly:

a. The M1 boat is a skiff type, flat-bottomed boat constructed of plywood. It is 13 feet 6 inches long, weighs about 200 pounds, and has a displacement of approximately 3,000 pounds with a 5-inch free-board (a capacity slightly smaller than that of the M2 assault boat).

It will carry safely, *in addition to* the two-man engineer crew, any one of the following loads of combat-equipped infantrymen and weapons:

- (1) Nine riflemen with individual weapons.
 - (2) Eight men, 1 caliber .30 light machine gun, and twenty boxes of ammunition.
 - (3) Eight men, 1 caliber .30 heavy machine gun, and thirteen boxes of ammunition.
 - (4) Eight men, 1 caliber .50 machine gun, and four boxes of ammunition.
 - (5) Seven men, one 81-mm mortar, and 50 rounds of ammunition; or nine men, one 60-mm mortar, and 150 rounds of ammunition.
 - (6) Seven men and equipment of infantry communication platoon wire section.
- b. The M1 assault boat is not equipped with hinge connections for making assault boat pontons.

CHAPTER 3

INFANTRY SUPPORT RAFT

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III. Construction_	24-27
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V. Preparation of treadway support_	33-35
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SECTION I

PURPOSE, COMPOSITION, AND ASSIGNMENT OF EQUIPAGE

	Paragraph
Purpose_	12
Composition_	13
Assignment of equipage_	14

12. Purpose.—*a.* The infantry support raft is used to ferry combat vehicles of not more than eight tons gross weight. Construction of rafts is initiated during the second phase of a river crossing.

b. The assault boats used in construction of the rafts may be used to cross the initial waves of the infantry covering force. As soon as these boats become available and the situation permits, rafts are constructed and put into operation.

13. Composition.—Each raft requires six assault boats (M2) connected in pairs, stern-to-stern, to form three assault boat pontons; eight plywood treadways, six for decking on the raft and two for approaches; six siderails; twelve siderail clamps; one 22-horsepower outboard motor; 42 canoe paddles; and four guy lines. All of the equipment for a complete raft (plus certain spares), constituting one unit of raft equipage (table I), is carried on one truck and trailer.

14. Assignment of equipage.—The light ponton company is assigned twelve infantry support rafts, and army engineer depots stock additional raft equipage. No other engineer organization is assigned the infantry support raft.

TABLE I.—*Infantry support raft*

(One unit of raft equipage carried on one truck and trailer)

Article	Basic quantity	Spares	Total
Assault boat M2, complete with connecting pin----	6	0	6
Siderail, 4 by 6 inches by 12 feet-----	6	2	8
Clamp, siderail-----	12	2	14
Motor, outboard, 22-horsepower with accessories, spare parts, and chest-----	1	0	1
Paddle, assault boat, with carrying case (seven per case)-----	42	0	42
Pin, assault boat connecting-----	0	2	2
Pin, treadway connecting-----	0	2	2
Rope, manila, ½-inch, 50 foot (guy line)-----	4	0	4
Treadway, plywood, complete with two connecting pins-----	8	0	8

SECTION II

DESCRIPTION OF EQUIPAGE

	Paragraph
Assault boat-----	15
Plywood treadway-----	16
Treadway connecting pin-----	17
Siderails-----	18
Clamps-----	19
Guy lines-----	20
Outboard motors-----	21
Raft accessories chest-----	22
Trailer-----	23

15. Assault boat.—The assault boat M2 is described in paragraph 5.

16. Plywood treadway.—A plywood treadway has an over-all length of 14 feet, a depth of 7 inches, and a width of 3 feet 1 inch. The covered treadway length is 12 feet. Each treadway is equipped with two steel connecting pins which are held in place, when not in use, by connecting pin locks located in the sides of the treadway. A flexible joint is made by engaging the fingers and inserting a connecting pin through the outer sets of holes of two treadways. A rigid joint is made by interlocking the fingers of one treadway with the fingers of the second and inserting two connecting pins, one through each treadway. Two pins must be used with each fixed joint to prevent damaging treadways. Each treadway has one nonskid sanded surface, which is always placed up. It is painted with olive-drab paint. (See fig. 11.)

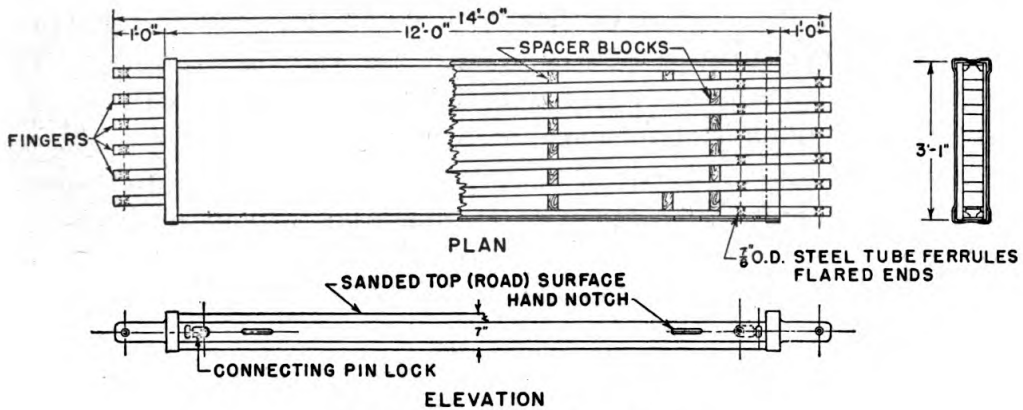


FIGURE 11.—Plywood treadway.

17. Treadway connecting pin.—Two treadway connecting pins, included as a part of each plywood treadway, are held in place in the treadway by connecting pin spring locks. The pin is L-shaped and has a 5-inch handle. It is 2 feet 11½ inches long, ⅝ inch in diameter, and is made of corrosion-resisting steel.

18. Siderails.—Six siderails are used to strengthen the raft and to prevent vehicles from leaving the treadways. The siderails are timbers, 4 by 6 inches by 12 feet. In the construction of a raft, the siderails are placed along the inside edges of the plywood treadway and are clamped by siderail clamps to the under edges of the assault boat ponton gunwales. (See fig. 12.)

19. Clamps.—Twelve clamps are used in each raft to hold together the siderails, plywood treadways, and assault boat pontons. The clamp is identical with the siderail clamp used with the 10-ton ponton equipage; it weighs about 10 pounds.

20. Guy lines.—Four guy lines are used to aline the raft during construction and to hold it during loading and unloading of vehicles. Each raft is furnished 200 feet of ½-inch manila rope for this purpose.

21. Outboard motors.—Each raft unit includes one 22-horsepower outboard motor complete with accessories, spare parts, and wooden carrying chest. The empty chest weighs 100 pounds; with spare parts and accessories it weighs 150 pounds; the motor weighs 124 pounds. The motor runs 40 minutes on one filling (2½ gallons) of fuel. Fuel mixture information is printed on the gas tank of each motor. To prevent loss of the motors while they are in use, a light line is attached from the motor to the handrail of the float.

22. Raft accessories chest.—One wooden chest is included with each raft to carry the siderail clamps and spare connecting pins.

23. Trailer.—The two-wheel utility trailer used to transport the infantry support raft has a truck-type suspension and a rectangular-

shaped open chassis of steel members. The drawbar is telescopic, permitting three adjustments of length for various loadings. The empty trailer weighs approximately 2,000 pounds and will carry a load of 4,000 pounds, but when the trailer is towed by a 2½-ton truck the load must not exceed 3,300 pounds. Hand-operated screws, lashings, and chain links are used to hold the load in position.

SECTION III

CONSTRUCTION

	Paragraph
Site selection.....	24
Preparation of site.....	25
Preparation of equipage.....	26
Construction of raft.....	27

24. Site selection.—A raft site should possess the following characteristics:

a. Approaches.—Short, easily constructed approach roads from existing road net to site. Prior construction of the near-shore approach is often essential in order to get raft equipment to the river. The far-shore and near-shore sites need not be directly opposite one another.

b. Current.—A gentle current is desirable. Location of site in a straight reach or gentle bend is favorable.

c. Bed.—Bed of river should be free from snags, rocks, shoals, and other obstructions which would interfere with movement of rafts.

d. Banks.—Banks should not be so high or steep as to require excessive grading for the approach. They should be firm enough to support the approach.

e. Cleared area.—A small cleared area at the near-shore site is needed for unloading and stacking assault boats, treadways, clamps, etc.

f. Tactical considerations.—Tactical considerations governing selection of sites are covered in FM 5-6.

25. Preparation of site.—The approach road from the existing highway net is constructed, and the site cleared to provide space required for construction and loading of rafts. The raft equipage is moved forward to the raft construction sites. Preparation of the site, including preparation of the treadway support (sec. V), should be completed by the time the assault boats are available for raft construction.

26. Preparation of equipage.—The raft can be built either directly from the trailer and truck loads, or from equipage previously

stacked at the site. The raft equipage should be placed close to the construction site. Extra time is required for raft construction when boat connecting or treadway connecting pins are bent, when boat hinge connections are bent, fouled, or iced, or when there is dirt or gravel between treadway fingers.

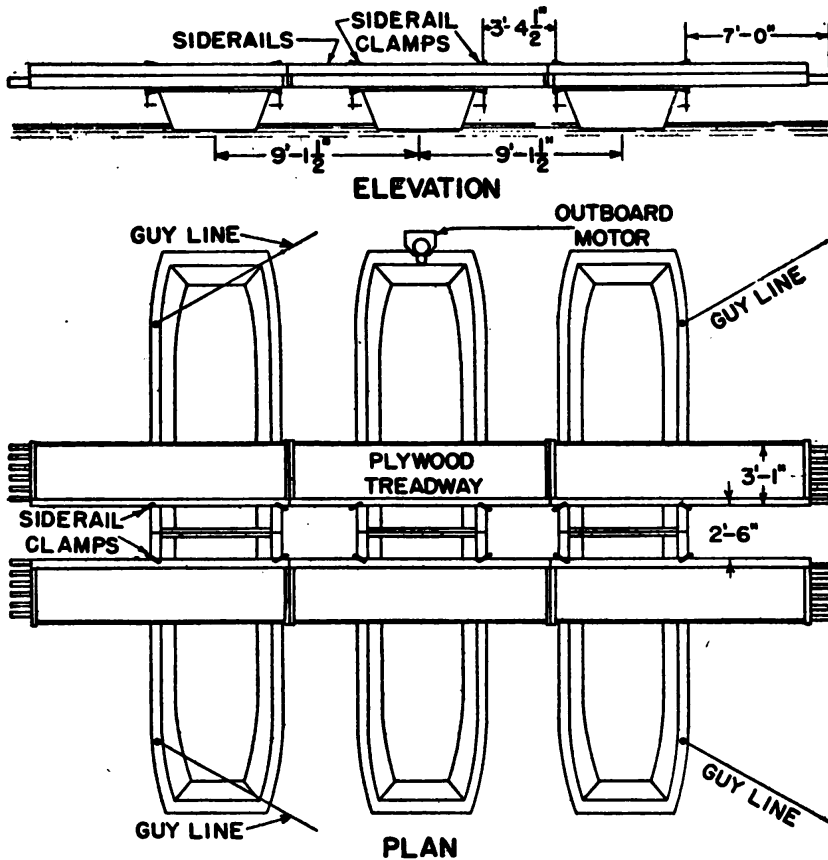


FIGURE 12.—Infantry support raft (sketch).

27. Construction of raft.—The equipage for a standard raft consists of 6 assault boats, 8 plywood treadways, 6 siderails, 12 siderail clamps, 1 outboard motor, and 4 guy lines. A completed raft, less outboard motor and guy lines, is shown in figure 12. One raft may be constructed in approximately 5 minutes as follows:

a. (1) Two assault boats are placed stern-to-stern, parallel to shore, and fastened together with two boat connecting pins to make an assault boat ponton (fig. 13). A line is fastened to each end and held or payed out as raft is built.

(2) Two plywood treadways are balanced across the gunwales of ponton between inner treadway spacers (fig. 14).

(3) Two more treadways are carried forward and their ends inserted into shore ends of first pair (fig. 15); two treadway connecting pins are inserted at each joint to form the rigid connection.



FIGURE 13.—Two assault boats M2 being joined stern-to-stern.

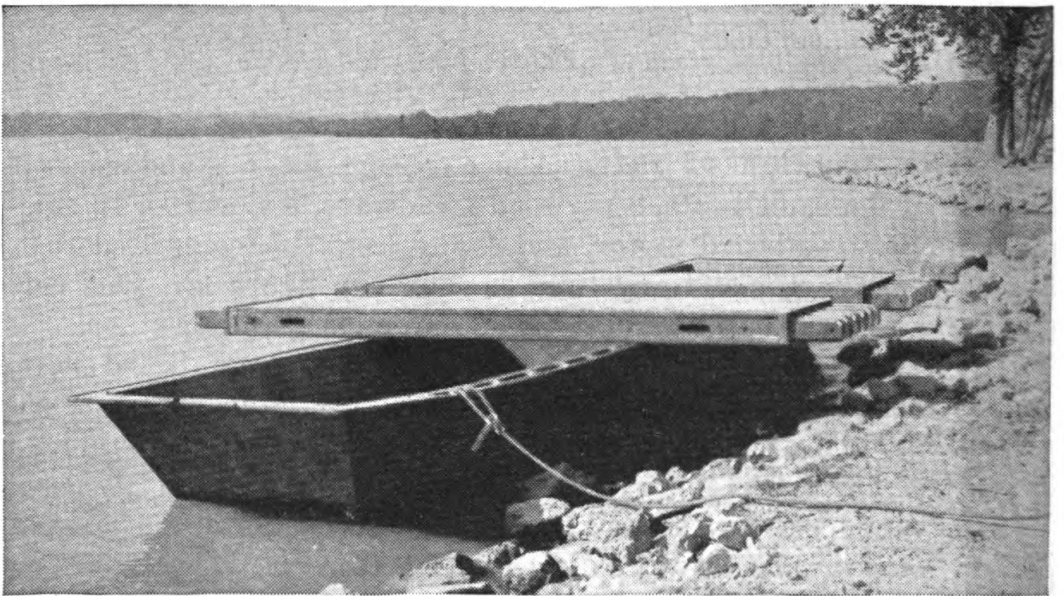


FIGURE 14.—First pair of treadways placed on first assault boat ponton.

(4) Shore ends of connected treadways are lifted to allow second assault boat ponton to be centered under second pair of treadways (fig. 16) and far assault boat ponton is shifted into correct position as shown in figure 17.

(5) Another pair of treadways is connected to second pair. Shoreward ends of treadways are raised to permit third assault boat ponton



FIGURE 15.—Connecting second pair of treadways.

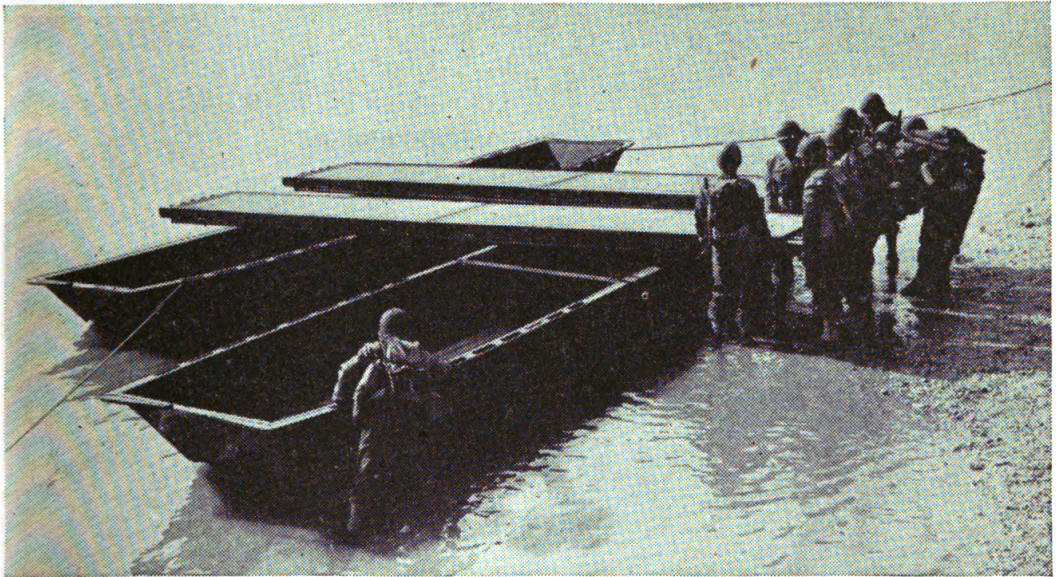


FIGURE 16.—Second assault boat ponton being installed.

to be placed in correct position under them (fig. 18). Joint between second and third pairs of treadways should be next to riverward handrail of third assault boat ponton. A guy line is fastened to each end of third assault boat ponton.

- b. (1) A siderail is placed above inside edge of each treadway.
- (2) Twelve siderail clamps are used to fasten siderails, treadways,

and assault boat pontoons together. Screw part of clamp is placed under ponton handrail, fixed part over top of siderail, and clamp is fastened securely.

c. Two treadways used to unload and load raft are placed across gunwales of pontoons.

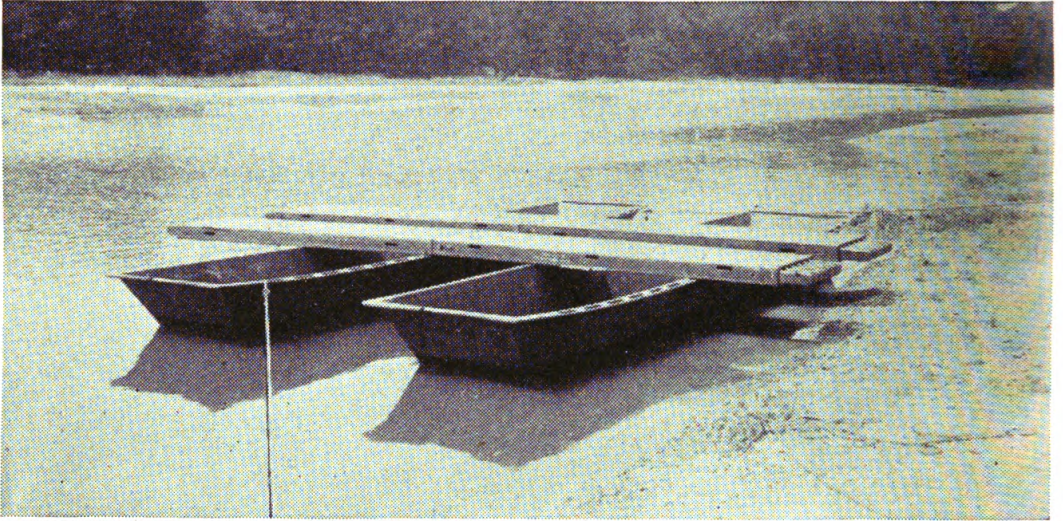


FIGURE 17.—Second assault boat ponton installed.

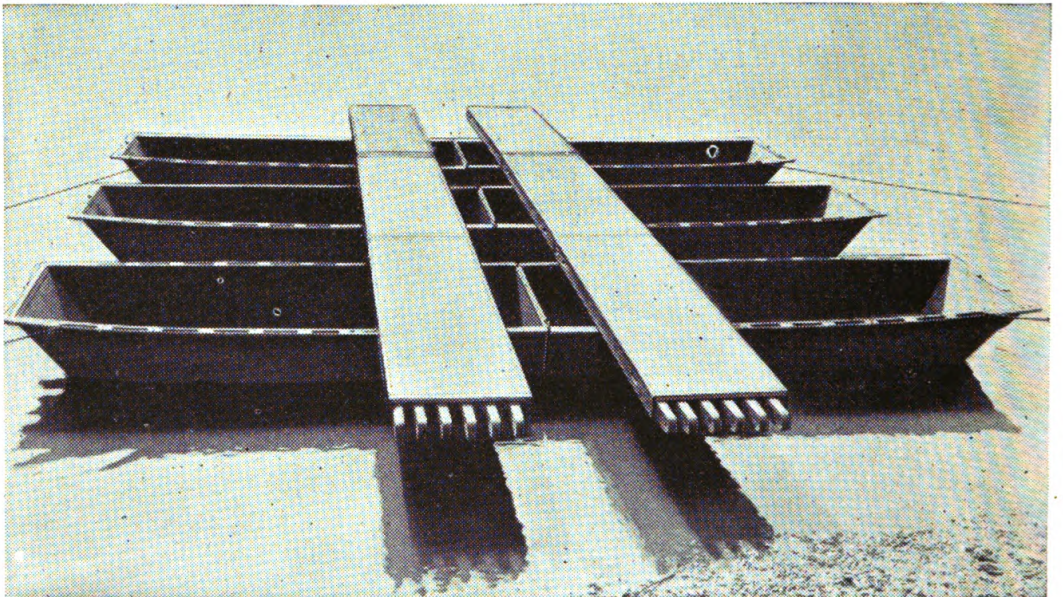


FIGURE 18.—Third assault boat ponton installed.

d. Outboard motor is clamped to downstream end of center ponton (fig. 19) and motor is prepared for operation.

e. Raft is now complete and ready to transport infantry ammunition and weapons carriers to far shore. Construction of another raft is initiated immediately by construction detail. Raft loads from a previously prepared support (sec. V).

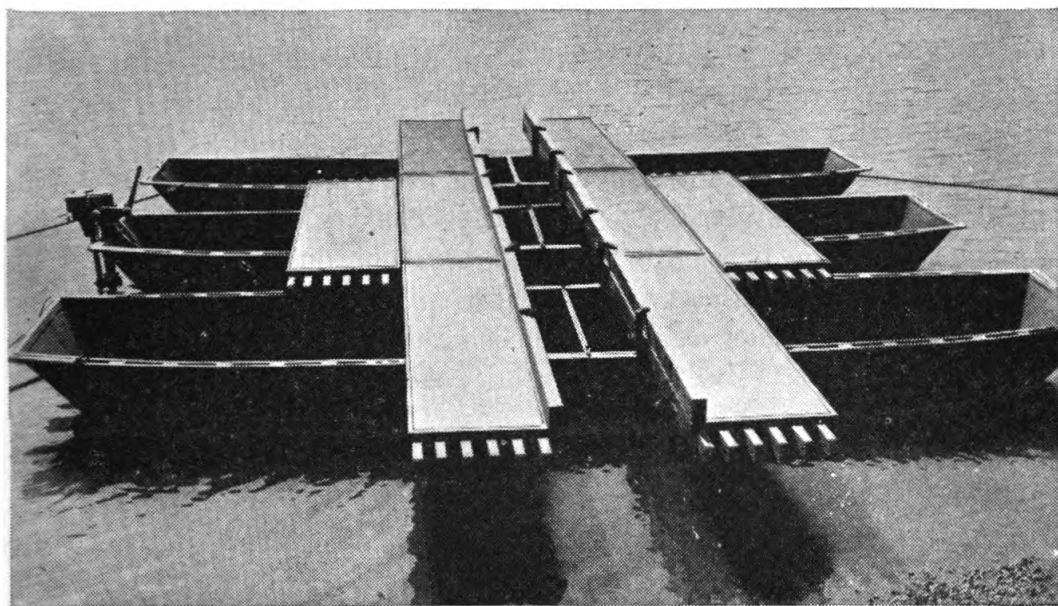


FIGURE 19.—Completed raft.

SECTION IV

DUTIES OF SECTIONS

	Paragraph
General	28
Boat-carrying section	29
Treadway-carrying section	30
River assembly section	31
Guy line section	32

28. General.—*a.* The working parties required for the construction of the raft are the boat-carrying, the treadway-carrying, the river assembly, and the guy line sections. A suggested organization to construct the raft follows:

	<i>Noncom- missioned officers</i>	<i>Men</i>
Boat-carrying	1	16
Treadway-carrying	1	16
River assembly	1	4
Guy line	—	4
	—	—
	3	40

b. This organization allows rapid construction of the initial raft and of succeeding rafts at the same site. When the raft is constructed of boats resting on the shore, sufficient personnel is provided to launch two boats at a time; when the raft is constructed from boats already afloat, the boat-carrying section is reduced to eight men, who maneuver the boats into place.

29. Boat-carrying section.—*a.* This section consists of one non-commissioned officer and sixteen men, additional men being added if boats must be carried a long distance. Eight men are required to carry each assault boat.

b. The section carries, launches, and delivers two boats at a time to the river assembly section. The section then carries, launches, and connects the boats for the next two pontons of the raft. The section also moves these pontons into place beneath the treadway.

c. The section then delivers, places, and fastens the siderails after the treadways have been placed and spaced by the treadway-carrying and river assembly sections.

30. Treadway-carrying section.—*a.* This section consists of one noncommissioned officer and sixteen men. Eight men are required to carry a treadway, and the number must be increased when it is to be carried a long distance.

b. The first pair of treadways is brought down and balanced across the first assault boat ponton.

c. The second pair of treadways is connected. The treadway-carrying section raises the shore ends of the connected treadways so that the boat-carrying section may push the second assault boat ponton under them.

d. The third pair of treadways is connected and the third assault boat ponton inserted as described in *c* above.

e. The section then places the two approach treadways, as directed by the officer in charge, at the near-shore end of the raft treadways.

31. River assembly section.—*a.* This section consists of one non-commissioned officer and four men. The section takes its place in the water and receives the first two boats from the boat-carrying section.

b. The first assault boat ponton is assembled and held in position by the river assembly section while the first pair of treadways is placed by the treadway-carrying section.

c. When the second pair of treadways is connected, the river assembly section assists in joining them together and then inserts the two treadway connecting pins in each joint to form the rigid connection.

d. The first assault boat ponton is shifted into its correct position by the river assembly section.

e. The section then assists the treadway carriers in connecting the third pair of treadways.

32. Guy line section.—This section consists of four men. The section attaches a 50-foot guy line to each end of the riverward assault boat ponton and holds it in position (fig. 12). The lines are payed

out as required. When the last ponton is placed, guy lines are attached to each end of the near-shore ponton. The guy line section holds the raft with lines while it is being loaded.

SECTION V

PREPARATION OF TREADWAY SUPPORT

	Paragraph
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Shore support.....	35

33. General.—A solid support must be provided as a bearing for projecting ends of the shore treadways of the raft when loading or unloading heavy vehicles. Depending on the site, this support may be located either in shallow water or on shore.

34. Shallow water support.—*a.* The shallow water support is employed where the water close to shore is too shallow to float the loaded raft within reach of a shore support. It is preferable that there be water at least 20 inches deep within less than 20 feet of shore, as in figure 20. Approach treadways are connected to shore treadways by means of hinge joints as shown. The top of the support should be approximately 4 to 6 inches above water level. It may be constructed of chess bound together with rope, or of planks, logs, or cribbing.

b. As shown in figure 20, the shore treadway of the raft deck rides clear of the support before the raft is loaded. During loading, the weight of the vehicle presses the end of the shore treadway down firmly to rest upon the support (fig. 21). When the vehicle is loaded and the approach treadway is disconnected, the shore treadway of the deck again rides free of the support as shown. If the raft cannot be brought to within 20 feet of shore, the approach can be extended by means of additional treadways.

35. Shore support.—A shore support is utilized if the site has sufficient depth of water (20 inches or more) close to shore to float a loaded raft without grounding the assault boat pontons. The support is often established as shown in figure 22① with its top surface 4 to 6 inches above the water level. It may consist of firm earth cut to grade, of a gravel surface, or of a sill laid at the proper elevation. An approach treadway is required as shown for loading the raft but is not required for unloading. With site conditions as shown in figure 22②, the natural bank may be utilized as a shore support without special preparation. The ends of the treadways are held firmly against and upon the sloping bank by guy lines as vehicles are loaded or unloaded.

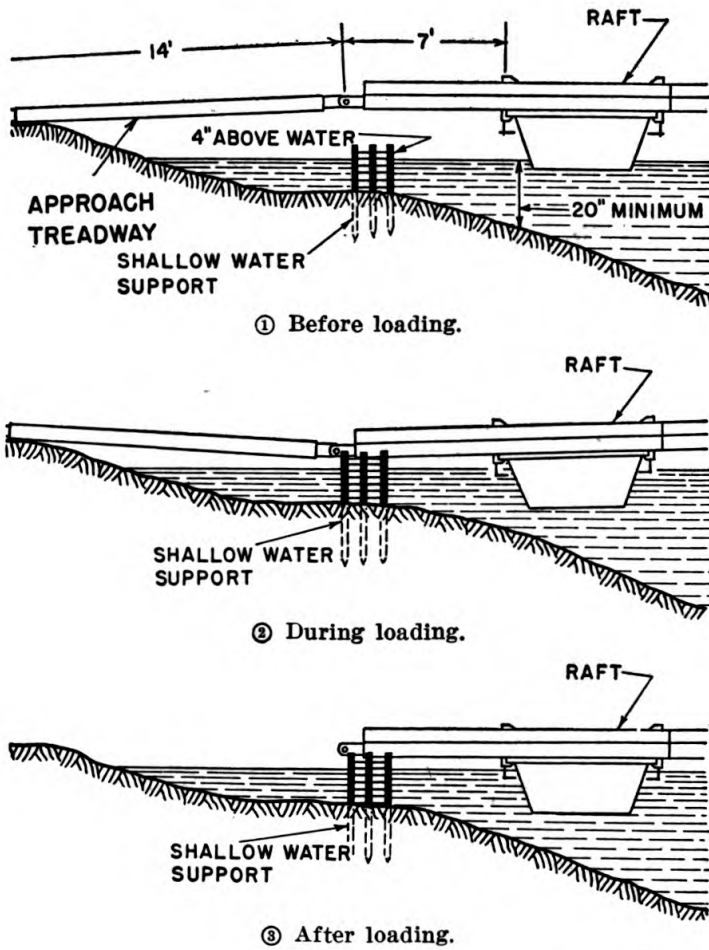


FIGURE 20.—Shallow water support.

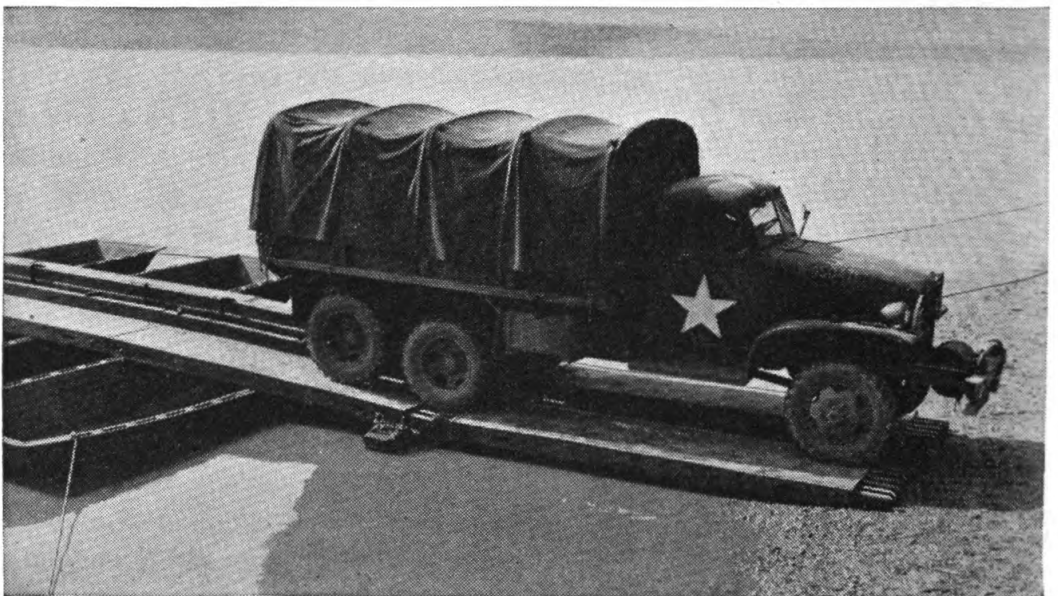


FIGURE 21.—Employment of shallow water support.

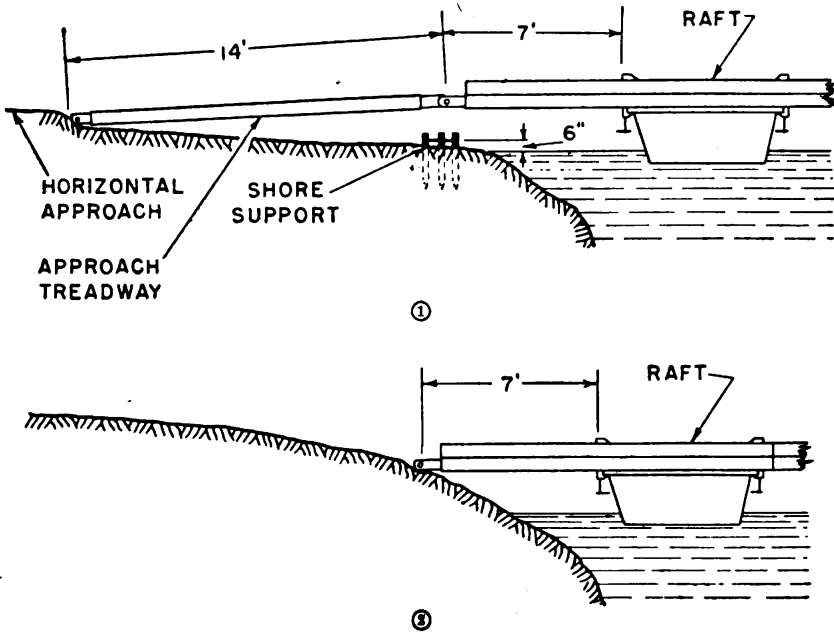


FIGURE 22.—Shore support.

SECTION VI

OPERATION

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Loading and unloading	37
Employment of outboard motor	38
Time required for crossing	39

36. Loads.—The raft will carry one loaded $2\frac{1}{2}$ -ton truck (fig. 23), one half-track car, or various combinations of lighter vehicles such as two command cars or three $\frac{1}{4}$ -ton trucks.

37. Loading and unloading.—The following precautions should be observed in loading and unloading:

a. Guy ropes should be firmly secured.

b. Rafts should be accurately placed with respect to treadway support.

c. Vehicles should move on and off raft at slow speed. All-wheel-drive should be employed with vehicles so equipped.

38. Employment of outboard motor.—Training and practice are necessary for efficient use of outboard motors to propel rafts. Motors can be used only in streams of sufficient depth. The propeller may be damaged by driftwood, and it must be kept free from weeds to maintain its efficiency. One motor attached to the center ponton is used to propel the raft. The raft should approach a landing with the forward ends of the floats pointing either into the wind or against the current, depending upon which is the stronger. This permits more effective control of the raft.



FIGURE 23.—Raft carrying 2½-ton truck.

39. Time required for crossing.—The width of the stream determines the time required for a raft to cross. A raft consisting of three assault boat pontons propelled by one 22-horsepower motor moves 5 to 6 miles per hour unloaded, and 2 to 3 miles per hour loaded. A three-ponton raft propelled by two 22-horsepower outboard motors moves 7 to 8 miles per hour when empty and 5 to 6 miles per hour loaded. Under favorable conditions, about 2 minutes are required to load or to unload one vehicle; the time required varies with the location.

SECTION VII

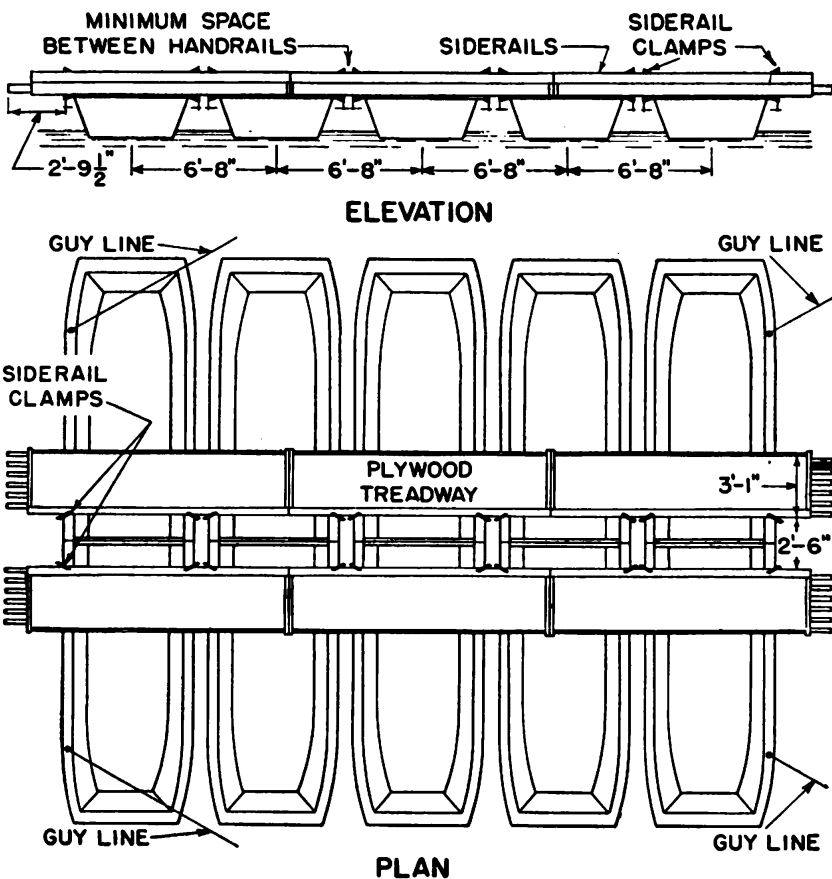
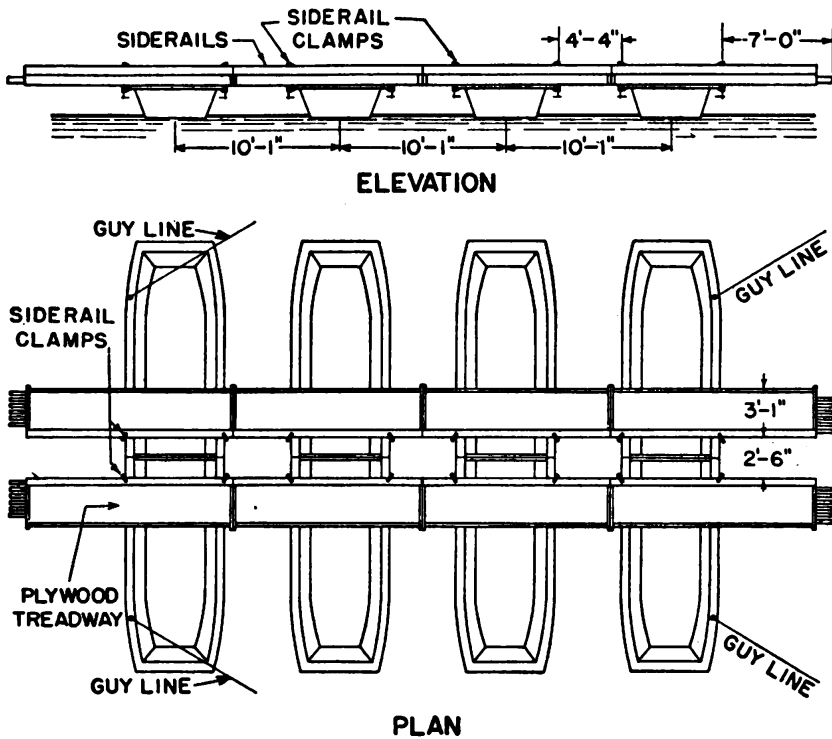
REINFORCED RAFTS

	Paragraph
General	40
Four-assault-boat ponton raft	41
Five-assault-boat ponton raft	42

40. General.—It is occasionally desirable to utilize the infantry support raft equipment to construct rafts of greater capacity than the standard raft.

41. Four-assault-boat ponton raft.—This raft (fig. 24) utilizes four assault boat pontons and a deck of eight treadways. The effective deck length is 48 feet. The raft is specially designed to accommodate a 105-mm howitzer towed by a 2½-ton truck.

42. Five-assault-boat ponton raft.—This raft (fig. 25) utilizes five assault boat pontons and a deck of six treadways. It is designed to take a medium tractor with angledozer.



SECTION VIII

EXPEDIENT ASSAULT BOAT BRIDGES

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Construction of double-treadway bridge.....	47
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43. Purpose and capacity.—As an expedient, infantry support raft equipage may be used to construct a bridge that will carry the ammunition and weapons carriers of an infantry division. Such a bridge will carry the loaded 2½-ton cargo truck. However, the bridge should not be left in continuous use, because of the light construction of both boats and treadways. The bridge is held in position with the ferry set material described in chapter 6. Approximately 190 feet of bridge can be built from the materials of six rafts.

44. Site selection and preparation.—The selection of the bridge site is based on the same factors as the infantry support raft site except that there must be a satisfactory far-shore site directly opposite the near-shore site. The approach roads to the expedient bridge require more preparation and maintenance than raft site approach roads because of the greater volume of traffic handled by the bridge.

45. Types of bridge.—The expedient assault boat bridge may be built either with a double-treadway deck similar to the deck of the infantry support raft, or with a solid, or triple-treadway, deck.

46. Expedient assault boat bridge with double-treadway deck.—*a.* The double-treadway bridge (fig. 26) has the following advantages over the triple-treadway bridge (fig. 29):

- (1) Can be constructed more quickly.
- (2) Requires fewer treadways.
- (3) Requires smaller construction party.

b. The double-treadway bridge has the following disadvantages as compared with the triple-treadway bridge:

- (1) Has considerably less traffic capacity, especially at night, when care must be taken to keep on treadways.
- (2) Is unsuitable for crossing horses or mules, because of center gap.

- (3) Is unsuitable for crossing solo motorcycles.

47. Construction of double-treadway bridge.—Construction of the double-treadway bridge is generally similar to that of the infantry support raft. The following organization is suggested for

construction by successive floats, using the equipage as it is unloaded from its transportation :

1 officer, to supervise construction

Section	Noncommissioned officer	Men
Boat-carrying -----	1	16
Treadway-carrying -----	1	16
River assembly -----	1	10
Siderail -----	1	8
Guy line -----	1	1 per line
or		
Anchor cable -----	1	8

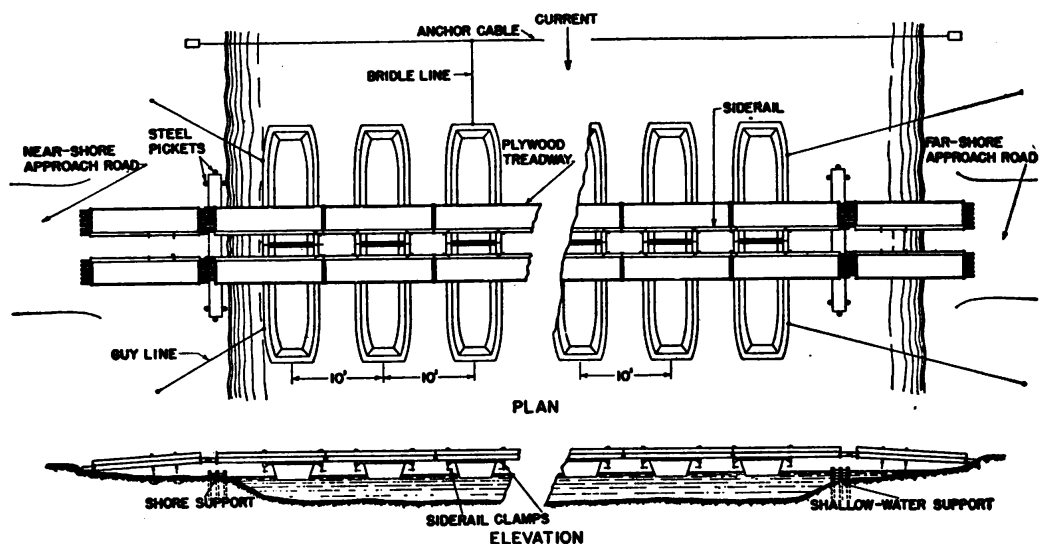


FIGURE 26.—Assault boat bridge with double-treadway deck.

48. Duties of sections.—*a. Boat-carrying section.*—This section, consisting of one noncommissioned officer and sixteen men, carries the assault boats two at a time from the trucks to the river and launches them. Eight men carry each boat.

b. Treadway-carrying section.—This section, consisting of one noncommissioned officer and sixteen men, carries the treadways to the river and places the treadway fingers into those of the treadways in the completed portion of the bridge so as to form a rigid joint between treadways. (See fig. 26.) Treadways are spaced between the inner set of treadway spacers as in the rafts. Each treadway is carried by eight men.

c. Siderail section.—The siderail section, consisting of one noncommissioned officer and eight men, delivers, places, and clamps the siderails to the assault boat pontons. A siderail is placed above the inside edge of each treadway with the 6-inch side vertical. They are

clamped to the ponton handrails with siderail clamps placed screw part down. Siderails are secured to approach treadways by siderail clamps placed with screw parts down, and, if necessary, holes are dug in the bank to prevent the lower ends of these clamps from striking the ground when vehicles pass over the approach treadways (fig. 26). Note that siderails cannot be placed on their 6-inch sides on the inside of the treadways and still accommodate the $\frac{1}{4}$ -ton truck.

d. River assembly section.—(1) The river assembly section, consisting of one noncommissioned officer and ten men, connects the assault boats to form assault boat pontons and places the treadway connecting pins in the treadway joints. The first bay of the bridge is constructed with treadways located the same on the assault boat ponton as on the infantry support raft. The second and following assault boat pontons are spaced 10 feet apart, center-to-center.

(2) Four men couple the assault boats to form assault boat pontons, and two men move them. Four men insert treadway connecting pins and shift the assault boat pontons under the treadways as required. The noncommissioned officer directs the near-shore assembly of the bridge.

e. Guy line section.—The guy line section consists of one noncommissioned officer and one man per guy line. Guy lines may be used when the length of the bridge does not exceed 150 feet and the current does not exceed 3 miles per hour; otherwise, anchor cables should be used. The guy line section attaches guy lines to the upstream and downstream ends of the far-shore assault boat ponton and to every sixth assault boat ponton therefrom.

f. Anchor cable section.—When an anchor cable is to be used, one section is needed to erect and maintain the anchor cable. The section consists of one noncommissioned officer and eight men.

(1) The anchor section unloads the materials and the assault boats required for erecting the cable.

(a) Two men who construct the near-shore holdfast carry the holdfast (with its pickets), one ratchet chain hoist, four cable clips, two cable grips, and the necessary tools to the point designated by the noncommissioned officer as the location for the near-shore holdfast (fig. 27).

(b) The remaining six men load into the boat the anchor cable, two improvised range poles, four cable clips, one holdfast with nine pickets, and the necessary tools and lashings for the construction and maintenance of the far-shore holdfast. (See fig. 27.)

(2) The free end of the cable is passed from the boat to the two men who prepare the near-shore holdfast. The noncommissioned officer steers the boat as it moves across the stream.

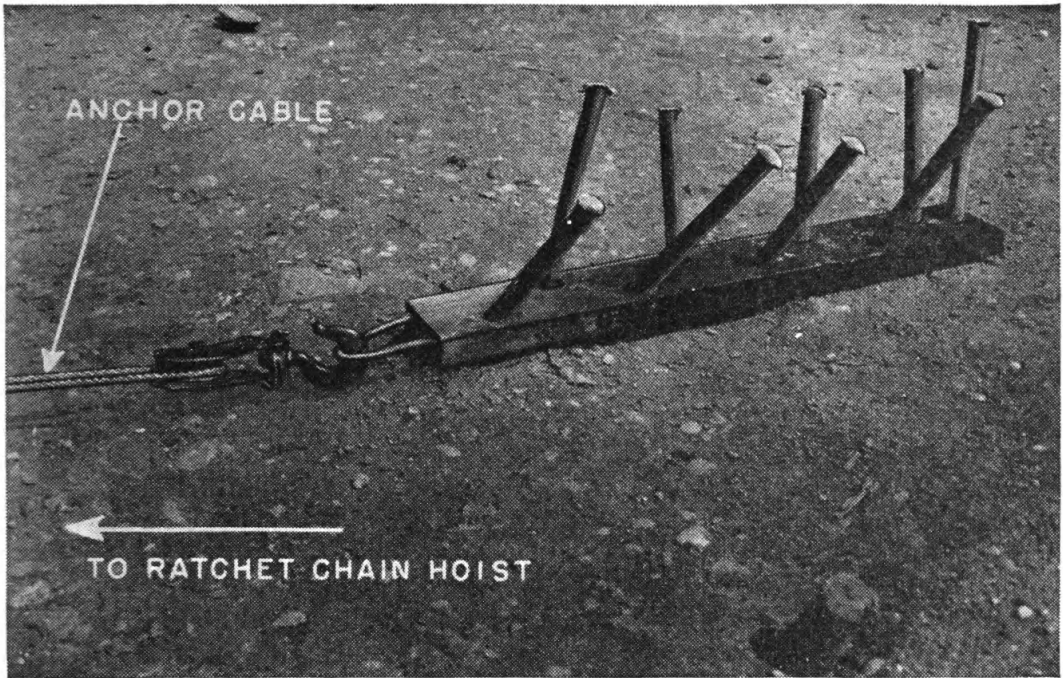


FIGURE 27.—Holdfast with anchor cable attached.

(3) Upon reaching the far shore, range poles marking the far-shore center line of the bridge are placed by the noncommissioned officer. He then designates the location of the far-shore anchor cable holdfast. The cable is attached to the completed holdfast by means of four cable clips and is then tightened by the two men on the near shore (fig. 28).

(4) One man remains on the far shore to maintain the far-shore holdfast; the noncommissioned officer and the remaining five men paddle back to the near shore.

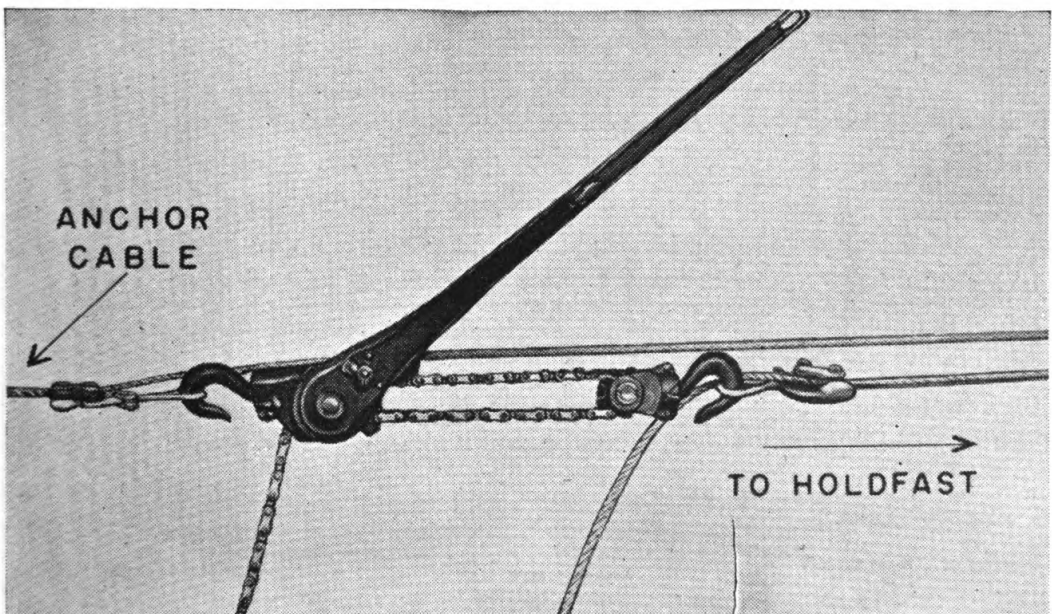


FIGURE 28.—Ratchet chain hoist used with cable grips to adjust anchor cable tension.

(5) One man remains to maintain the near-shore holdfast.

(6) The noncommissioned officer directs the attachment of the bridle lines to the anchor cable from the assault boat pontons. One bridle line is attached to the third assault boat ponton from the far-shore end of the bridge and to every sixth assault boat ponton therefrom. Each man attaches one end of a bridle line to the anchor cable, takes his place in an assault boat ponton as directed by the noncommissioned officer, adjusts the length of the bridle line as the assault boat ponton moves across the stream, and makes the final adjustment of the bridle line when the bridge reaches the far shore.

g. A rope may be attached to the far-shore end of the bridge to pull the completed portion toward the far shore as the bridge is constructed.

49. Abutment connections.—The ends of the floating portions of the bridge are connected to shore by hinge-joint-connected treadways. Supports for loading or unloading similar to those required for the rafts (par. 33) are also required for expedient assault boat bridges (figs. 20 and 21). Guy lines are attached to assault boat pontons and to the shore to assist in holding the bridge in place (fig. 26).

50. Expedient assault boat bridge with triple-treadway deck.—*a. Construction.*—The expedient triple-treadway bridge utilizes three plywood treadways per bay to provide a solid deck of 8 feet 8 inches clear width. The construction of this bridge is similar to that of the double-treadway bridge with the following exceptions (fig. 29):

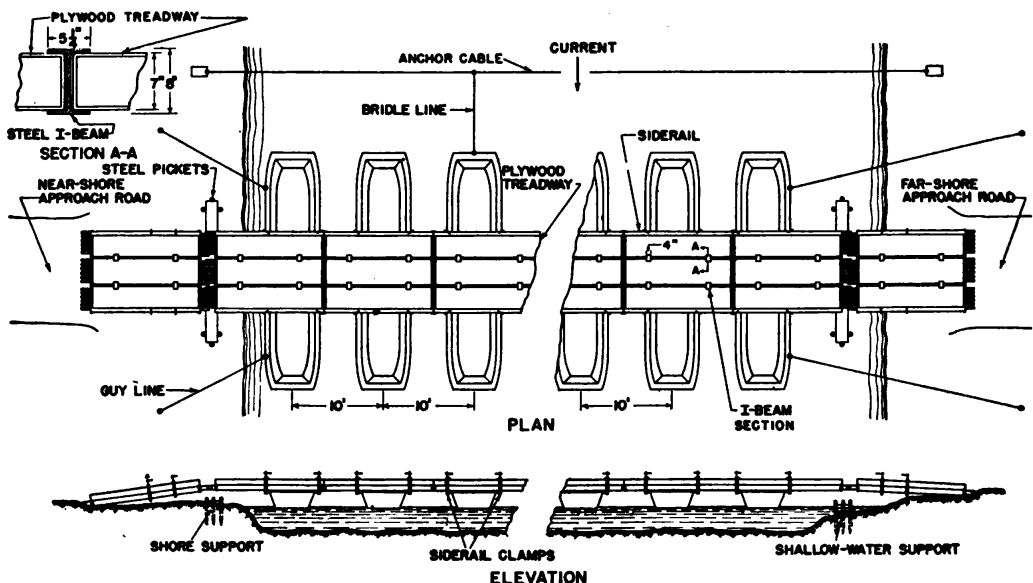


FIGURE 29.—Expedient assault boat bridge with triple-treadway deck,

(1) Three treadways are used in place of two.

(2) Two short I-beam sections are inserted between each outer treadway and the center treadway.

(3) All siderails are placed on outside edges of outer treadways; siderail clamps are placed with screw part up.

(4) The outer treadway set of spacers on the pontons are used.

b. Organization.—The organization for the triple-treadway bridge is the same as for construction of the double-treadway bridge with the following additions:

(1) The number of men in the treadway-carrying section is increased to twenty-four.

(2) One man is added to the river assembly section; his duty is to place the I-beam sections between adjacent treadways.

c. Abutment connection.—The abutment connections are made in the same manner as in the double-treadway bridge. (See par. 49 and fig. 29.)

SECTION IX

CARE, MAINTENANCE, AND TRANSPORTATION OF RAFT AND EXPEDIENT BRIDGE EQUIPAGE

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Boats.....	51
Plywood treadways.....	52
Siderails.....	54
Motors.....	54
Maintenance of bridge.....	55
Clamps and guy lines.....	56
Transportation of raft equipage.....	57

51. Boats.—The care and maintenance of assault boats is covered in chapter 2.

52. Plywood treadways.—Since treadways are made of plywood, they should be kept painted, dry, and well ventilated at all times when not in use. Holes of 3 inches or less in the sanded flooring of the treadways should be covered with sheet metal fastened with small nails. This prevents mud and leaves from entering and causing the stringers inside the treadways to rot and decay. Treadways with larger holes should be replaced. A finger should not be repaired in the field; this should be done in shops.

53. Siderails.—Siderails should be cleaned, inspected, and painted before they are stored.

54. Motors.—Dependable operation of outboard motors can be achieved by following the instructions contained in the manufacturer's instruction book. Men trained in the use of motors should be responsible for their operation and maintenance. The following points will aid in operating and maintaining outboard motors:

a. Specially built chests are provided and must always be used when transporting motors by truck. Motors must not be dropped, whether in chests or not. They should be covered when not in use.

b. Instructions issued by manufacturer regarding proper mixture of gasoline and oil and regarding spark plugs are especially important and must be followed *exactly*.

c. Dirty or wet spark plugs frequently cause failure of an outboard motor to start or to operate properly. Operator should always carry at least one set of clean, dry spark plugs in his pocket so that plugs can be replaced when necessary.

d. Operators should be prohibited from disassembling motor, except for changing spark plugs, inserting spare parts, and removing and cleaning fuel line screens. Other repairs should be performed in shops under supervision of skilled mechanics.

e. Operator should be trained in replacing shear pin, damaged propeller, and other parts for which spares are furnished with the motor.

f. After use, motor should be drained of all water while still in a vertical position; this prevents water from entering cylinders through exhaust ports, causing rusting and hard starting later. Motor should be kept free of water, oil, and dirt.

55. Maintenance of bridge.—Siderail clamps should be tightened regularly. Treadway connecting pins at the joints should be inspected to see that the pins do not work out. Damaged equipage should be replaced. Alinement of the bridge should be maintained as required.

56. Clamps and guy lines.—The clamps and guy lines should be kept clean and dry. Dampness seriously affects the life of rope; hence, provision should be made for cleaning, drying, and coiling the rope after use. This prevents grit from working into and cutting the fibers. The screw parts of the clamps should not be lubricated; this leads to an accumulation of dirt and dust that causes more serious fouling and damage than does lack of lubrication.

57. Transportation of raft equipage.—Attachment of rafts to an engineer battalion is normally in increments of six rafts together with two ferry sets (ch. 6) which are loaded on six 2½-ton trucks and six two-wheel utility trailers. A complete raft set is carried on one truck and one trailer. The six assault boats and six siderails are carried on the trailer. Assault boat may be carried upside down on the trailer to prevent accumulation of water inside the boats. Treadways, outboard motor, and the remaining small parts of the raft are carried upon the truck. The two ferry sets can be carried on any two of the trucks.

CHAPTER 4

FOOTBRIDGE, M1938

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Composition and assignment of equipage.....	59
Detailed description of equipage.....	60
Site requirements.....	61
Methods of construction.....	62
Movement of materials to bridge site.....	63
Organization for construction by successive bays.....	64
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Ferrying.....	69
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58. Purpose.—The footbridge is used for rapid passage of foot troops across a stream. When reinforced, it will also carry 37-mm guns.

59. Composition and assignment of equipage.—*a. Bridge unit.*—One unit (432 feet) of footbridge consists of—

Article	Number
Clip, wire rope, $\frac{3}{8}$ -inch.....	24
Duckboard, 12-foot.....	36
Float, 10-foot.....	72
Hook, boat, ball point, 10-foot handle.....	2
Picket, steel, 36-inch.....	32
Post, handrail, metal.....	72
Rope, manila, $\frac{1}{2}$ -inch, 30-foot lengths, with snaps on each end (bridle lines).....	36
Rope, manila, $\frac{1}{2}$ -inch, 500-foot lengths (handrail lines).....	2
Rope, manila, $\frac{1}{2}$ -inch, 750-foot lengths (guy lines).....	2
Rope, wire, $\frac{3}{8}$ -inch, galvanized, 6 by 19, cast steel, 600-foot lengths, with reel (float cable and anchor cable).....	4

b. Issue.—One unit of footbridge is issued to each light ponton company.

60. Detailed description of equipage.—*a. Duckboard.*—(1) The duckboard (see fig. 32) is made of white pine and consists of a series of transverse slats 1 by 7 by 22 inches mounted on two longi-

tudinal stringers $1\frac{5}{8}$ by $4\frac{1}{2}$ inches by 12 feet. The duckboard weighs approximately 100 pounds. The floor surface of the duckboard is covered with a skidproof paint. Each end of the duckboard has a male and a female fitting with which to attach the duckboard to adjacent duckboards. Spacer blocks are placed beneath the duckboard stringer to locate the duckboard on the floats.

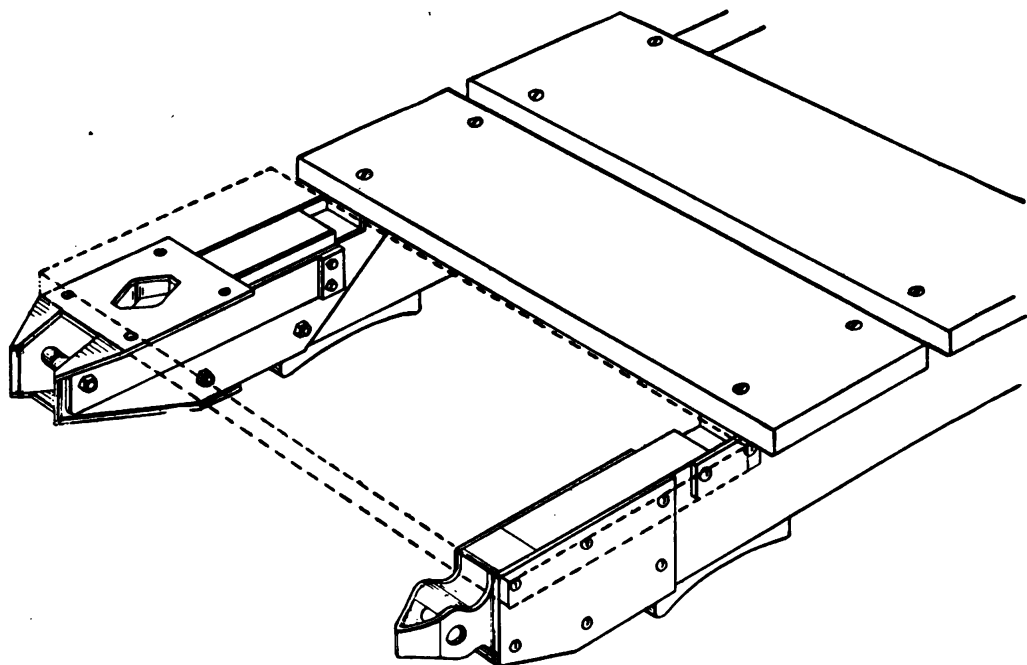


FIGURE 30.—Duckboard connectors.

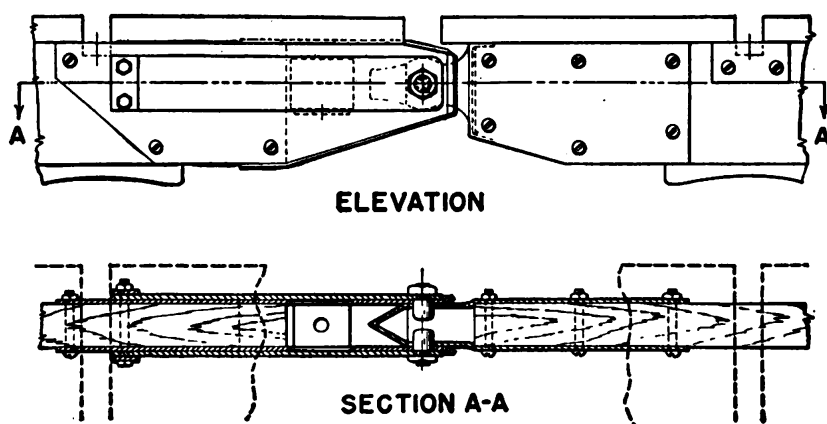


FIGURE 31.—Duckboard connectors, latched.

(2) To connect duckboards, force the wedge-shaped male fastening between the lugs of the female fastening until the lugs snap into the holes in the sides of the male fastening. The fastenings may be uncoupled, using the fitting at the top of the handrail post. The

fitting is inserted into the hole in the duckboard slat or crosspiece directly behind each female fastening and rotated until the leaves of the female fastener are pried open enough to release the male fastening.

b. Float.—(1) The float (see fig. 33) is a white-pine crate 10 feet long and 10 by 13½ inches in cross section. The crate contains layers of expanded rubber, the displacement of which gives buoyancy to the float. The float weighs approximately 85 pounds. It will support 400 pounds.

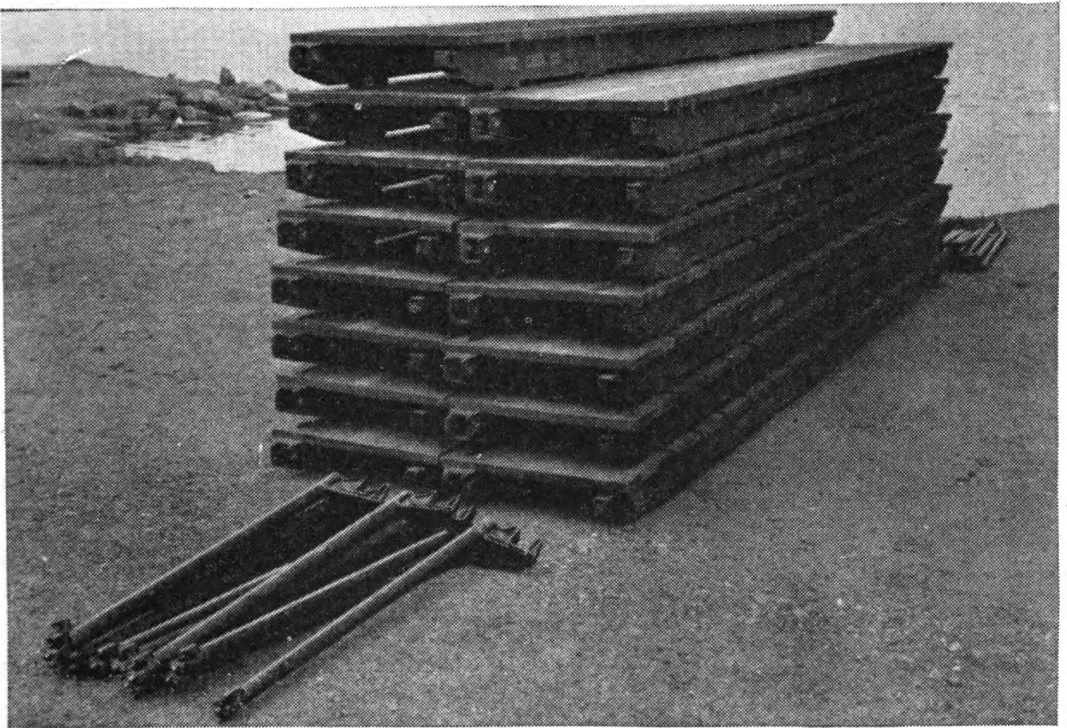


FIGURE 32.—Duckboards and handrail posts.

(2) A folding carrying handle is provided at each end of the float, and at each float end a hook is provided for the float cable attachment.

(3) Spring-tightened hooks are provided on top of each float for attachment of float to the duckboard or duckboards (three pairs of hooks to each float).

(4) To connect the float to the duckboard, the duckboard is placed on the float and the spring fasteners on both sides of the duckboard are lifted and hooked over the duckboard stringers. The handles of the hooks are then moved clear of the footway. (See figs. 34 and 35.)

c. Handrail post.—The aluminum handrail post has a bronze fitting at the top which serves as a receiver for the handrail manila line and

also as a tool to disengage the duckboard fasteners. The post is attached to the duckboard stringer by means of a slot in the bottom of the post. Two posts per bay are used, one on each side of the duckboard.

d. Cables and lines.—The anchor cable and bridle lines are used to guide the bridge during construction, to aid in alining it after construction, and to hold it in final position. The guy lines are used for

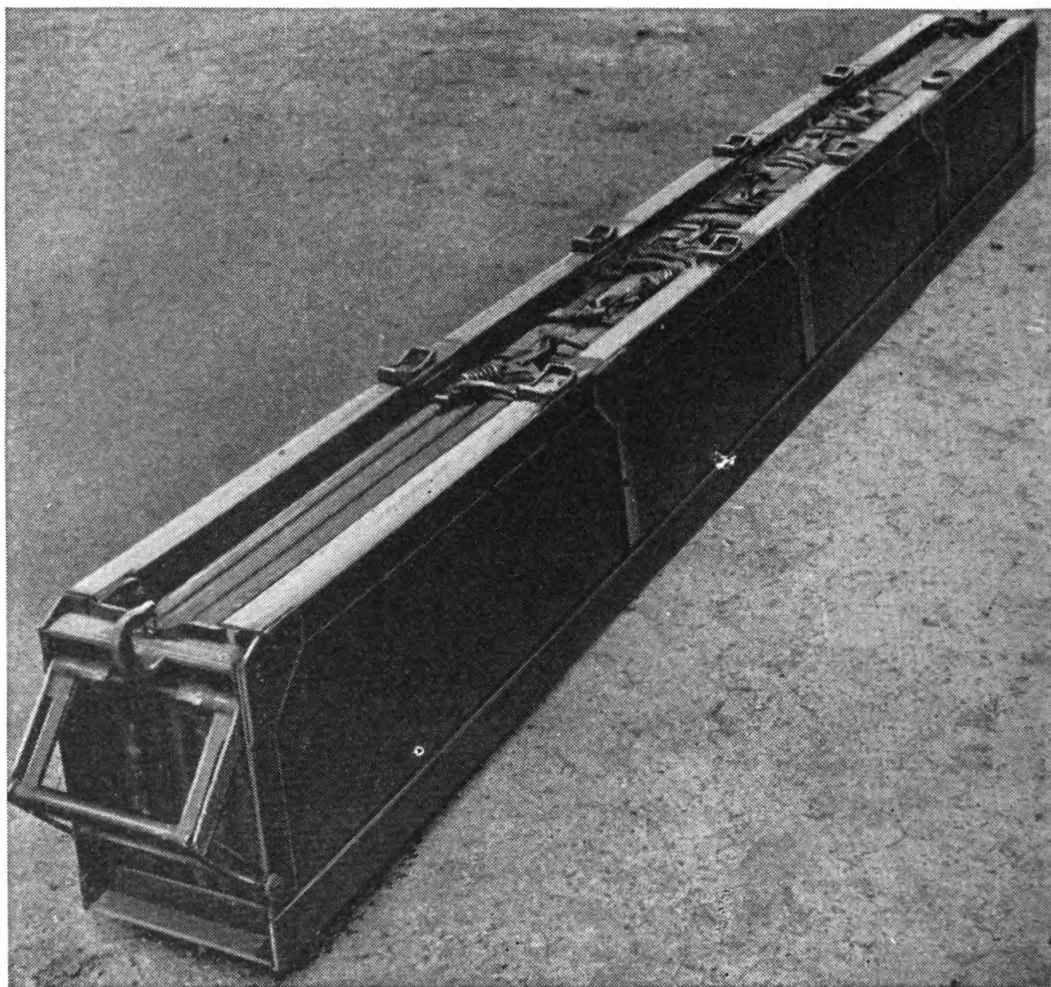


FIGURE 33.—Float.

the same purpose as the anchor cable and bridle lines but guy lines are used only when the bridge is built in still water. The float cable prevents the submerging and overturning of the footbridge by swift currents while the bridge is in use; the cable is attached to the upstream side of the bridge.

61. Site requirements.—The site requirements are similar to site requirements for other floating bridges. Tactical requirements of sites are given in FM 5-6.

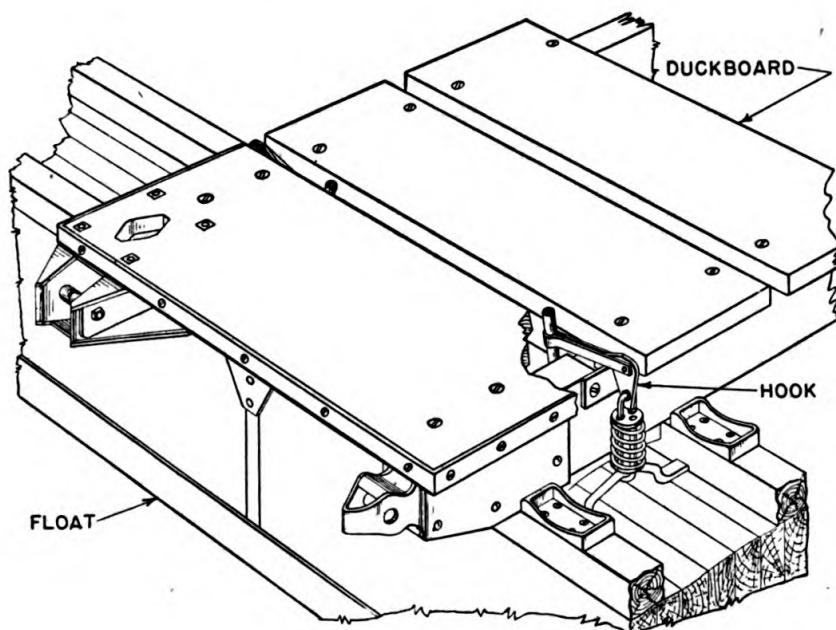


FIGURE 34.—Float attached to duckboard.

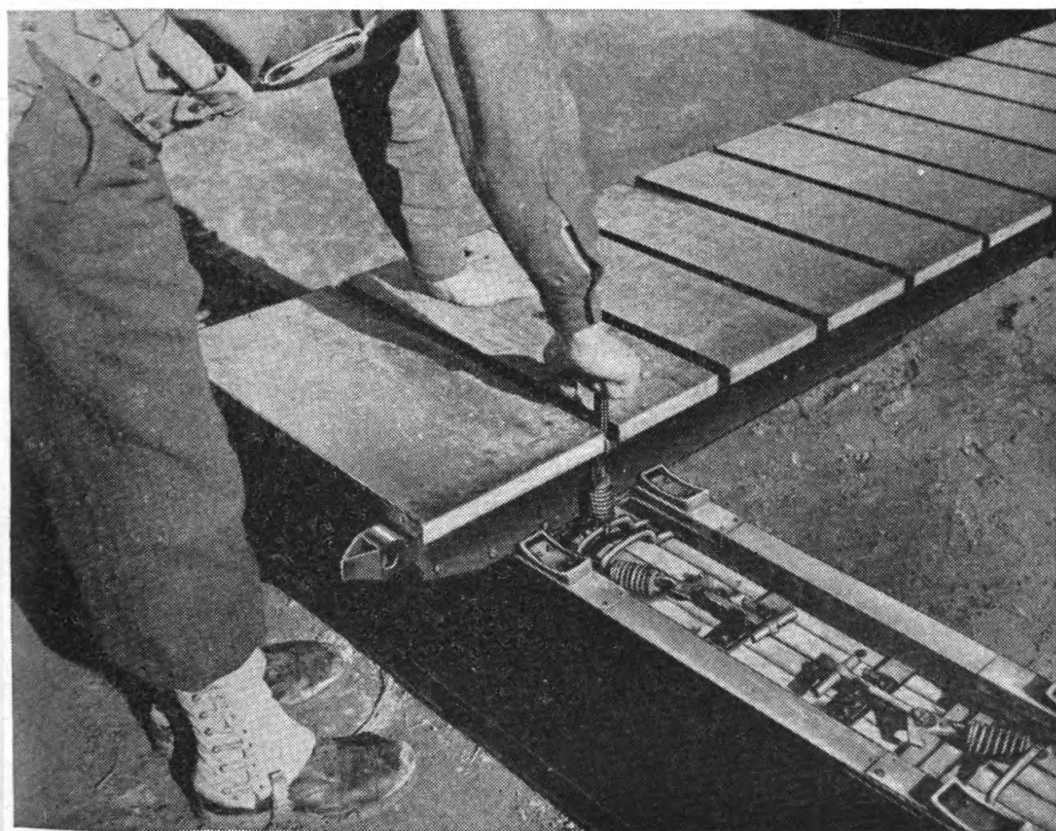


FIGURE 35.—Fastening duckboard to float.

a. The bridge should be on a road, path, or other cleared approach that will facilitate carrying the bridge equipment to the site and permit the rapid movement of foot troops across the bridge.

b. A small cleared area on the near shore large enough for shore assembly of bridge parts facilitates construction.

c. Preferably, the stream bottom at the site should be firm and should slope so that water about 6 inches deep is reached at a distance of 2 or 3 feet from the shore. It is preferable that water not over waist deep should be reached 20 to 30 feet from shore.

d. These ideal site conditions are seldom found; the time of construction is increased when they are not fulfilled.

62. Methods of construction.—*a. By successive bays.*—The normal method of construction is by successive bays. A bay consists of one duckboard, two floats, and two handrail posts. Single bays are successively assembled on shore, carried into the water, and connected to the near-shore end of the completed portion of the bridge. The completed portion of the bridge is then moved the length of one bay farther across the stream so that the next bay may be floated and connected. Anchor cables and bridle lines, or guy lines, may be used with this type of construction. The bridge can be constructed in this manner at the rate of 20 to 30 feet per minute.

b. By sections.—With this method, two or more bays are assembled on shore, launched, and attached as a unit to the shore end of the completed portion. This method requires more men, more time, and closer supervision of working parties than construction by successive bays.

c. Land assembly and launching as a unit.—The entire bridge may be completely constructed on shore, picked up as a unit, carried out into the water, and pushed across the waterway. This method is applicable to the erection of a bridge across a narrow and sluggish waterway. This method is impracticable when steep banks, brush, trees, or rough ground are present at the bridge site.

63. Movement of materials to bridge site.—*a.* The footbridge equipment is brought forward in trucks to a point not far from the waterway to be crossed and is then hand-carried to the site. Equipment should arrive at the shore assembly site in the following order: cables, ropes, accessories, tools, duckboards, floats, and handrails. Carrying parties should be loaded and dispatched in that order.

b. For less than 300-yard hand-carries, the loads should be distributed as follows:

Duckboard_____	2 men.
Float_____	2 men.
Pickets, steel_____	4 per man.
Handrail posts_____	6 per man.
Bridle lines, 30-foot_____	15 to 20 per man.
Handrail lines, 500-foot_____	1 per man.
Guy line, 750-foot_____	2 men.
Float cable, 600-foot_____	4 men.
Anchor cable, 600-foot_____	4 men.
Extra assault boat (from ponton unit)_____	10 men.

About 260 men are required to carry an entire unit of the bridge at one time.



FIGURE 36.—Floats and duckboards stacked at site.

c. As materials arrive at the site, equipment should be stacked in convenient order. Materials for anchor cables and holdfasts are prepared immediately. Floats are placed at one side of the template and duckboards and handrail posts on the other. When sufficient space is not available at construction site, materials may be stacked a short distance from it and carried up as needed.

64. Organization for construction by successive bays.—a. General.—The footbridge is usually constructed by successive addition of single bays to the near-shore end.

b. Officers.—Bridge construction should be under the supervision of an officer or noncommissioned officer. Supply of bridge materials to site should be controlled by a second officer or noncommissioned officer.

c. Outline of organization and duties of sections.

Section	Non-commissioned officers	Men	Duties
(1) Anchor cable (near-shore). -----		4	(1) Carry near-shore holdfast materials to site designated by noncommissioned officer of section. Receive and hold end of anchor cable from far-shore group. Prepare holdfast. Tighten and fasten shore end of cable upon order of section noncommissioned officer. Assist assembly-carrying detail to carry assembled bays.
(2) Far-shore -----	1	(	(2) (a) Procure from ponton unit-launch, and load assault boat with anchor cable and materials for preparing far-shore anchor cable holdfast. (Materials for preparing far-shore float cable holdfast are also loaded when float cable is used.) (b) Pass free end of anchor cable to near-shore group. Paddle to far shore while cable is payed out from boat. (c) Prepare far-shore anchor cable holdfast; attach cable to holdfast and signal near-shore group to tighten cable. (d) Signal near-shore assembly section when end of bridge is two bays from far shore. (e) As first bay reaches shore, shoreward float is removed and duckboard fastened in place. (Float cable is attached to prepared holdfast and near-shore section signaled to tighten cable, when cable is used.) Make bridge fast to far shore.
(3) Bridle line -----	1	1 per line	(3) Prepare and attach bridle lines to centers of duckboards as directed. Each line is attached to anchor cable and then handled by one man. One man is located on far end of completed portion of bridge and remainder are spaced with their lines at proper intervals as bridge is assembled. Alinement of bridge is maintained by handling of lines as bridge moves across river. As soon as bridge reaches far shore, final alinement is made and bridle lines made fast to duckboards. Men then move to near shore.

Section	Non-commissioned officers	Men	Duties
(4) Guy line-----	1	2 per line	(4) (a) Attach upstream and downstream guy lines to first bay of bridge. Handle lines to aline and direct movement of bridge across waterway; two men per line. Aline bridge and fasten lines. (b) Attach upstream and downstream lines to duckboards of other bays of bridge. Lines are handled by two men per line. Aline bridge and fasten lines. Place pickets for fastening all guy lines to shore.
(5) Shore assembly---	1	8	(5) Procure materials and assemble floats to duckboards. Two men handle each float, two men handle each duckboard, and two place handrails: total eight men. Prepare template for alining floats so that duckboard may be quickly placed and hooked. Noncommissioned officer directs work. Place two floats in template, place duckboard with handrail posts on the two floats, fasten float clamps, and release to assembly-carrying section.
(6) Assembly carrying-	1	4	(6) Carry assembled single bay from shore assembly site to shoreward end of completed section of bridge (one man at each end of the two floats). Launch bay and release to river assembly section.
(7) River assembly---	1	6	(7) Four men receive bay from assembly-carrying section, move bay to near-shore end of bridge, and couple new bay to completed portion of bridge by engaging male and female duckboard fittings together. Two men hold completed portion of bridge and assist in making connection. Noncommissioned officer kneels on end of bridge and assists. All six men push bridge out length of added bay.

Section	Non-commissioned officers	Men	Duties
(8) Handrail line-----		3	(8) One man of handrail section makes lines fast to river end of first duckboard and then takes post on bridge near inshore end and threads handrail lines through handrail posts on each side as bridge is pushed out. Two men remain on near shore, one upstream and one downstream from bridge, to pay out lines and make them fast to pickets on near shore when bridge is completed.
(9) Float cable-----		4	(9) (a) Carry float cable and near-shore holdfast materials to point designated by noncommissioned officer of anchor cable section. (b) One man prepares float cable holdfast on near shore; two men prepare support for cable reel and pay out cable; one man attaches free end of cable to first duckboard and places cable in hook at upstream end of each float, except first float of bridge.

65. Construction procedure.—*a. Officer in charge.*—The officer or noncommissioned officer in charge of construction—

(1) Has working parties formed.

(2) Issues instructions as to whether anchor cables or guy lines are to be used.

(3) Designates points where upstream ends of floats enter water at near shore and leave water on far shore.

(4) After section leaders instruct their sections, gives command: **CONSTRUCT BRIDGE.**

(5) Exercises general supervision over all parts of work.

b. Use of cables or guy lines.—(1) *Anchor cable.*—(a) The anchor cable (fig. 37) is always used except when the the waterway has little current. The anchor cable must be placed and secured before bridge construction begins. The anchor cable section carries the assault boat, obtained from the ponton unit, and the necessary materials to the point upstream where the cable is to cross the stream. The boat is loaded with the anchor cable on its reel, a stick on which reel may turn, pickets, lashings, and sledges.

(b) The four men of the near-shore part of the section remain ashore to hold the end of the anchor cable while it is being unreel

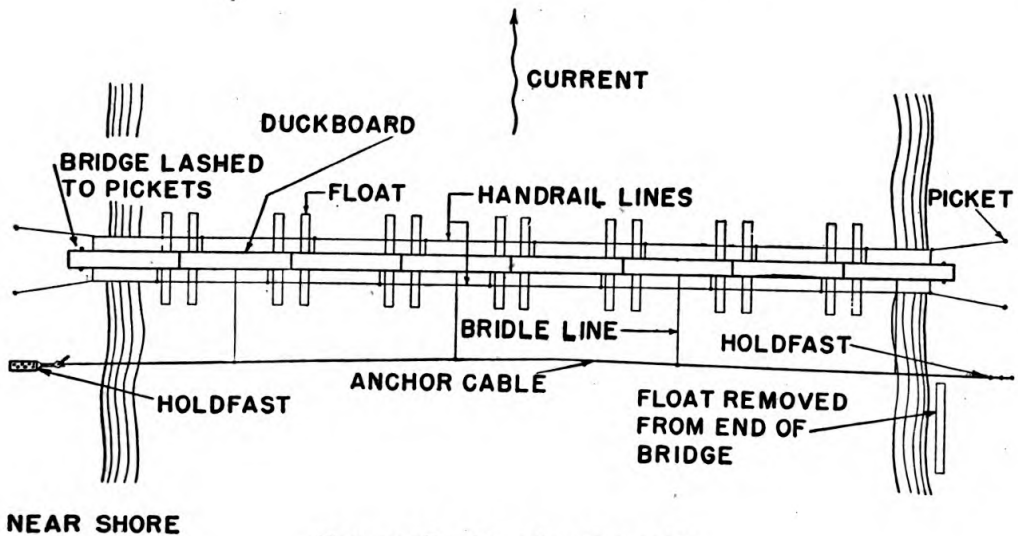


FIGURE 37.—Use of anchor cable.

from the boat, to prepare a holdfast when a suitable one does not exist, and to secure the cable to the holdfast. The noncommissioned officer and the far-shore detail of six men paddle across the stream. (See fig. 38.) Two men hold the reel in the center of the boat and allow cable to unreel as the boat crosses the stream. The noncommissioned officer steers and the remaining men paddle. Upon reaching the far shore, the boat is unloaded. The noncommissioned officer utilizes a natural holdfast (tree stump) for the anchor cable if one is available; otherwise, he directs installation of a prepared holdfast. Anchor cable is then made fast and the near-shore group ordered to tighten it.

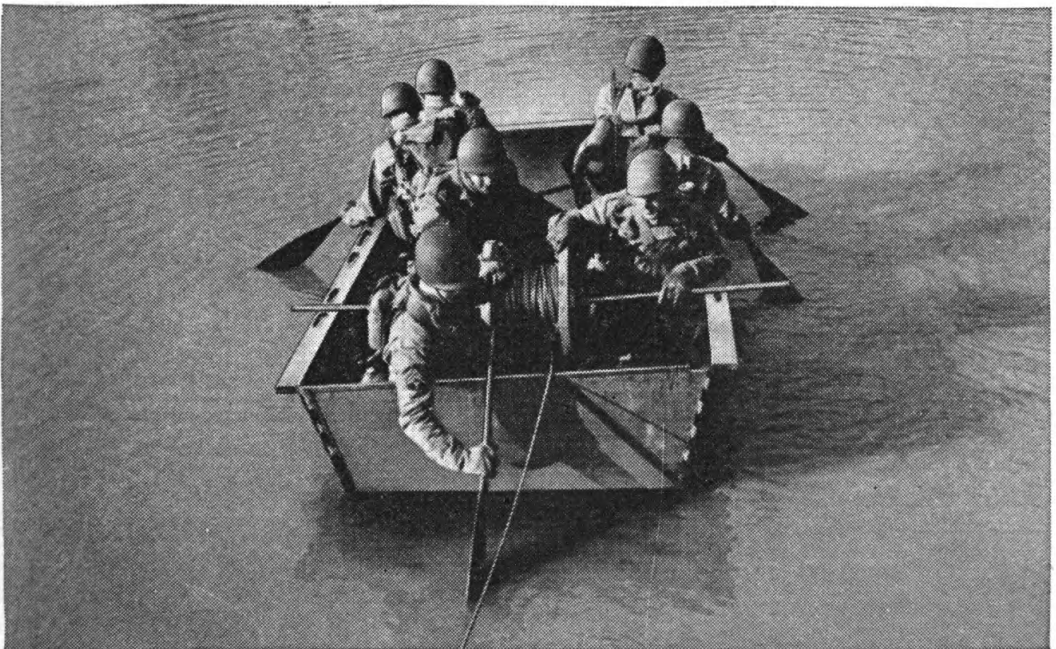


FIGURE 38.—Anchor cable being carried across stream in assault boat.

(c) When the float cable (fig. 39) is used, a second holdfast is prepared for it on the far shore. The far-shore men then stand by to assist in landing the bridge. At the moment when only two more bays are required to complete bridge, the noncommissioned officer signals the fact to the near shore.

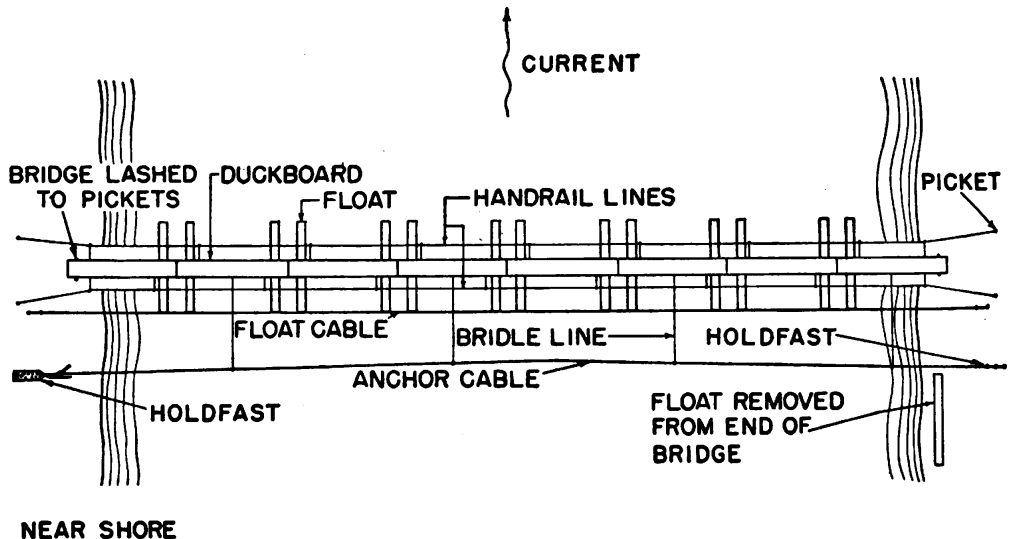


FIGURE 39.—Use of float cable and anchor cable.

(d) The near-shore group joins the assembly-carrying detail when work on anchor cable is completed.

(2) *Guy lines.*—Guy lines are used to guide the bridge across waterways with little current. Lines are attached as the bridge is under construction. The noncommissioned officer in charge of the guy line section indicates location and number of lines to be attached and location of holdfasts for the lines. Lines are made fast to duckboards. The first two lines are made fast to the riverward end of the bridge. (See figs. 40 and 45.) Men take positions at designated hold-

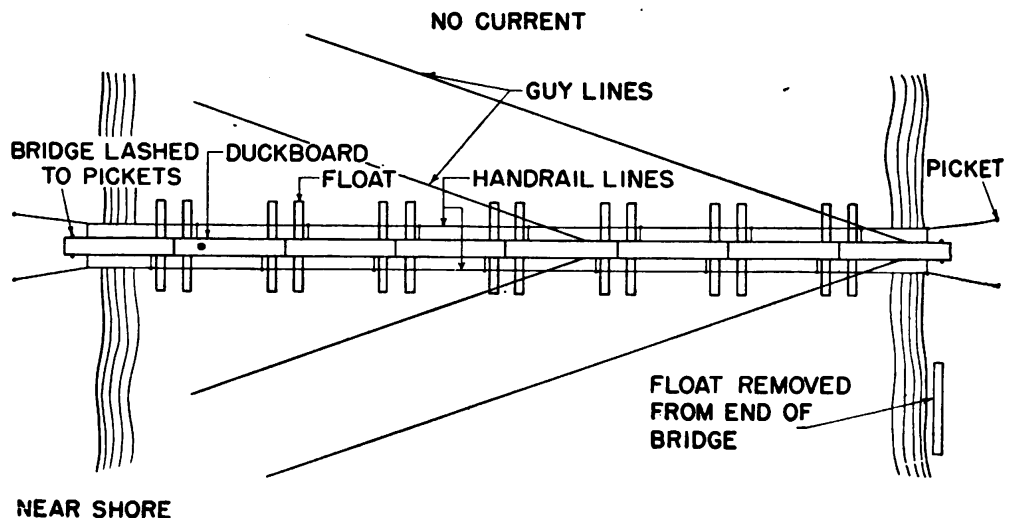


FIGURE 40.—Use of guy lines.

fasts and pay out lines, snubbing around the holdfasts when necessary to maintain alinement of the bridge. When the bridge is completed, it is alined and the guy lines are made fast to the shore pickets.

c. Assembly of bays.—(1) The shore assembly section attaches the duckboards to the floats and fastens the handrails to the duckboards. A template (see fig. 41) made of driftpins or stakes driven into the ground along one side and one end of each of the two floats facilitates assembly of bays. White tracing tape stretched between these stakes or driftpins is of assistance when the bridge is constructed at night.

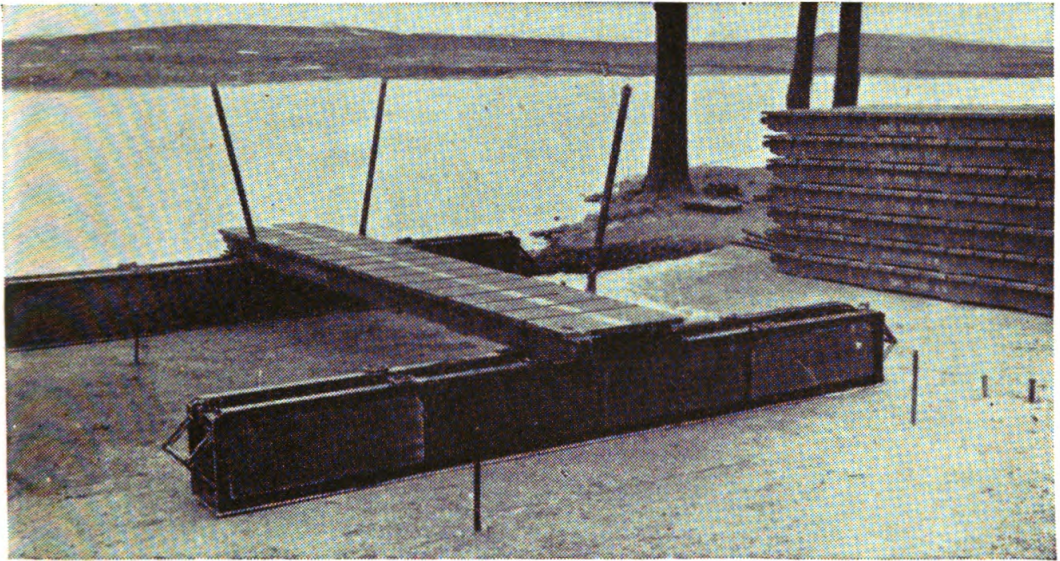


FIGURE 41.—Template for assembly of bay.

(2) Four men, two to each float, procure floats and place them in templates. Two men attach the handrail posts to the duckboard and two other men place the duckboard on the floats (see fig. 42). The men placing the floats connect them to the duckboard by means of the fasteners as soon as the duckboard is placed. (See fig. 35.)

d. Movement of assembled bay to bridge.—The assembly-carrying section removes bays from template, carries them to river, and launches them.

One man carries one end of each float of bay. Bay is picked up from template, carried into water, and turned over to river assembly section at a point near completed portion of bridge. (See fig. 43.)

e. Attaching bay to completed portion of bridge.—The river assembly section attaches the bay to the shoreward end of the completed bridge. The connection is made as follows: Four men move bay through water to end of bridge. The noncommissioned officer kneels on last bay of bridge, guides the joints together, and assists in making connection. (See fig. 44.) Two men of section who hold

near-shore end of the bridge also assist in making connection. After male and female joints have been connected, completed portion of bridge is moved riverward 12 feet and held there by two men.

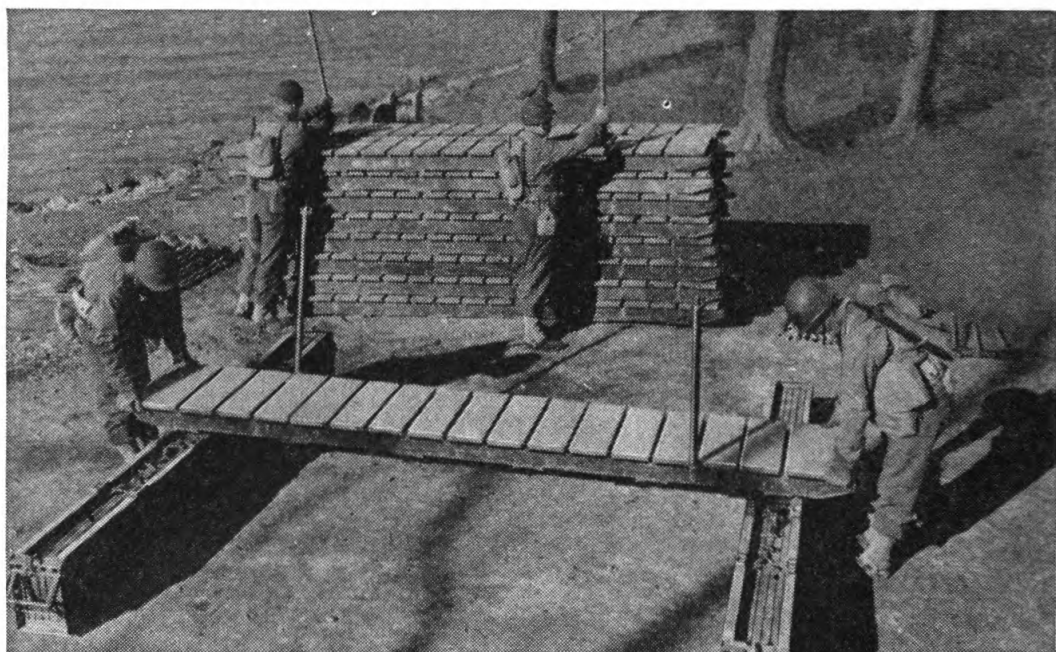


FIGURE 42.—Assembly of bay.

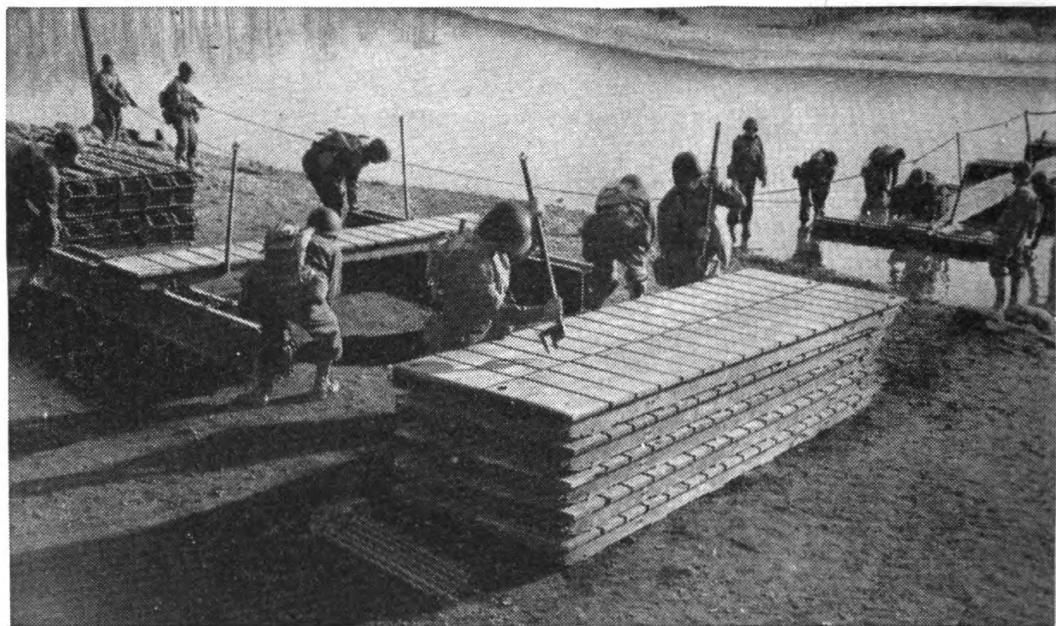


FIGURE 43.—Carrying assembled bay to waterway.

f. Attaching handrail lines.—One man of handrail section makes lines fast to river end of first duckboard and then takes post on bridge near inshore end, threading handrail lines through handrail posts on each side as bridge is pushed out. (See fig. 44.) The two

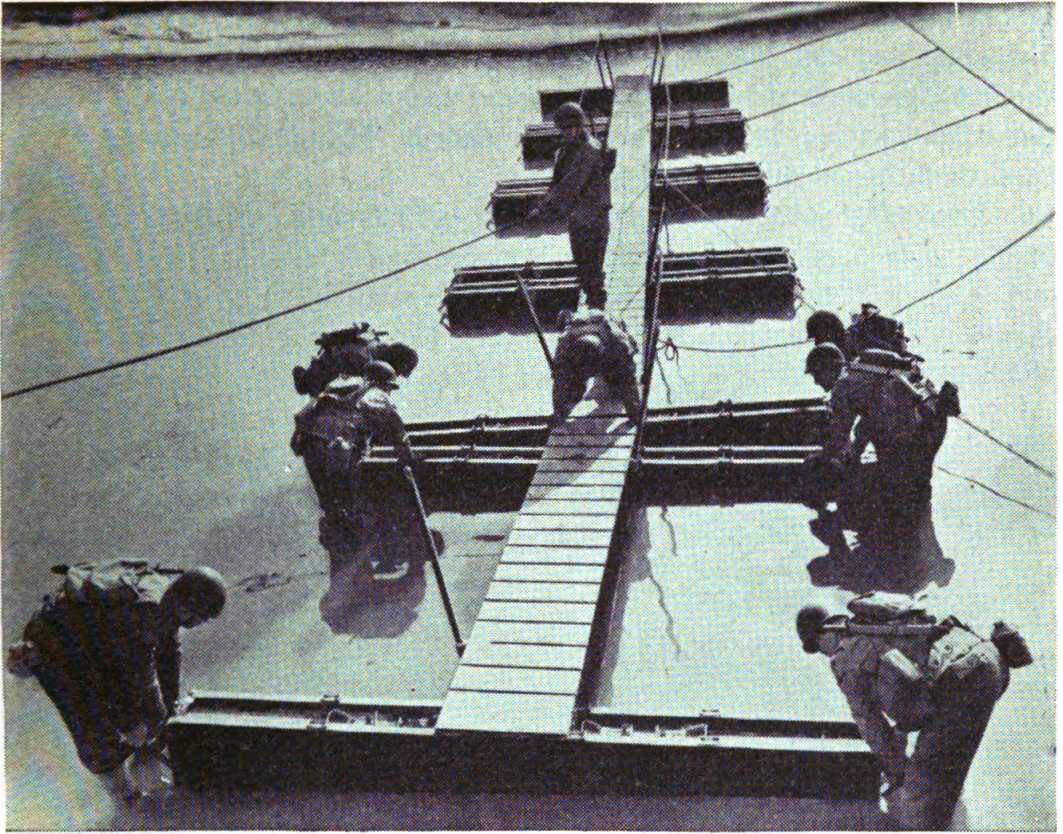


FIGURE 44.—Bay being connected to completed portion of bridge.

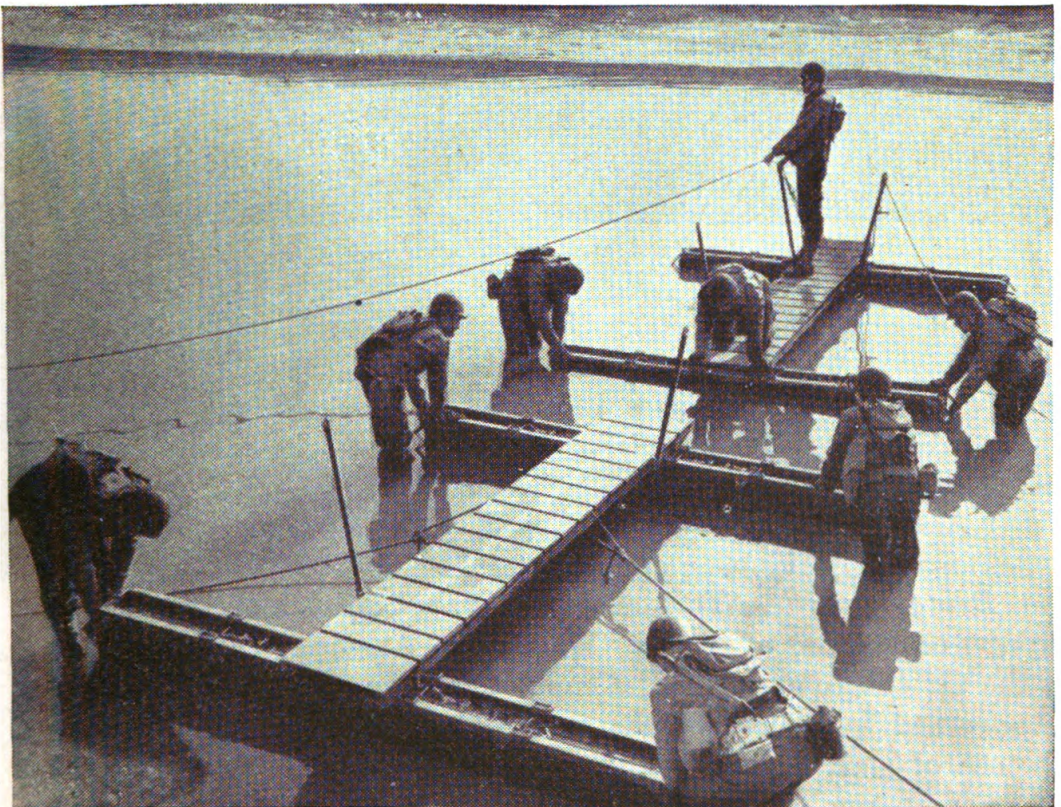


FIGURE 45.—Bay with guy lines attached being connected to bridge.

men remain on near shore, one upstream and one downstream from bridge, to pay out handrail lines and make them fast to near shore when bridge is completed. Far-shore detail makes fast the far-shore ends of lines when bridge reaches far shore. Handrail lines are fastened to shore as shown in figure 49.

g. Fastening shoreward duckboards.—Two men from shore assembly section place two pickets approximately 1 foot from shoreward end of near-shore duckboard and lash duckboard stringers to pickets. Two men from shore assembly section perform same operation on the far-shore end of bridge. (See fig. 48.)

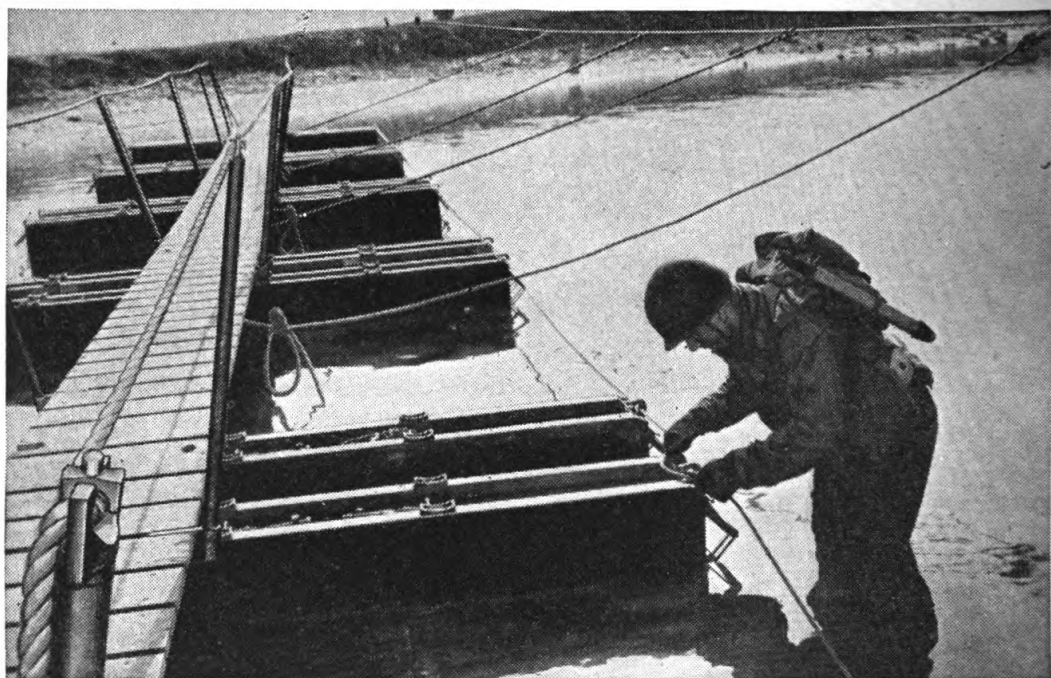


FIGURE 46.—Attaching float cable to float.

66. Use.—*a. Control.*—(1) Men should cross at double time and maintain intervals of about two paces. Too great concentration of loads on the bridge will cause a portion of it to submerge.

(2) A column should continue at double time until rear elements have cleared the bridge.

(3) About 75 men per minute can cross the bridge in daylight and 40 men per minute in the dark.

b. Bridge guards.—The officer in charge of bridge construction supervises crossing of troops. He stations a noncommissioned officer at the far end to expedite and control movement. Priority of traffic is governed by orders of the local or higher commander. In the absence of such orders, bridge traffic is controlled by the engineer officer in charge.

67. Dismantling bridge.—Working sections for dismantling are the same number and size as for construction. In general, the procedure is the reverse of bridge assembly. An exception is the float cable which is taken in at once to expedite the removal of bays

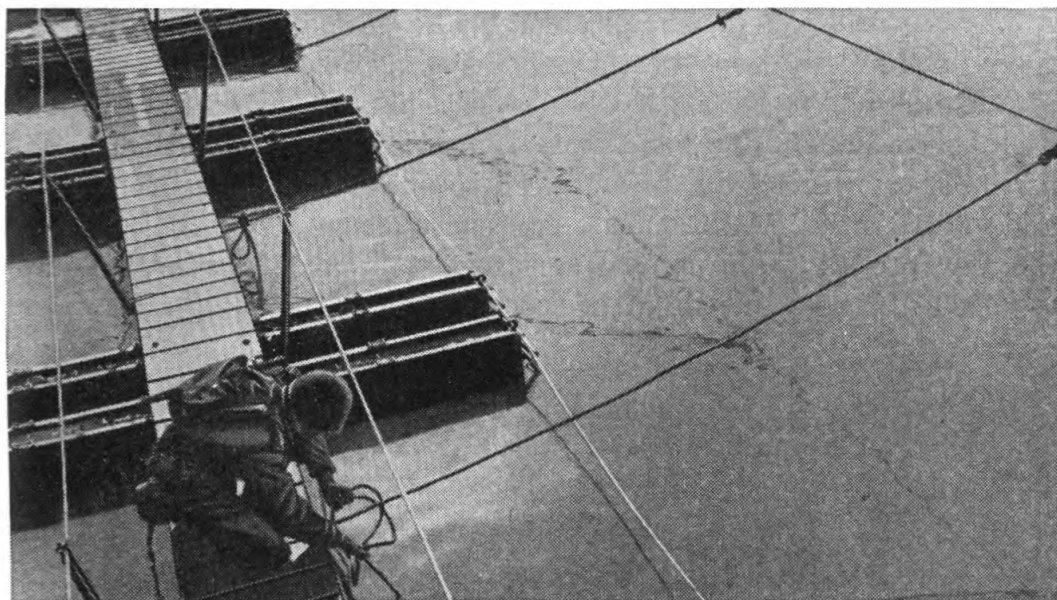


FIGURE 47.—Adjustment of bridle lines (float cable in place).

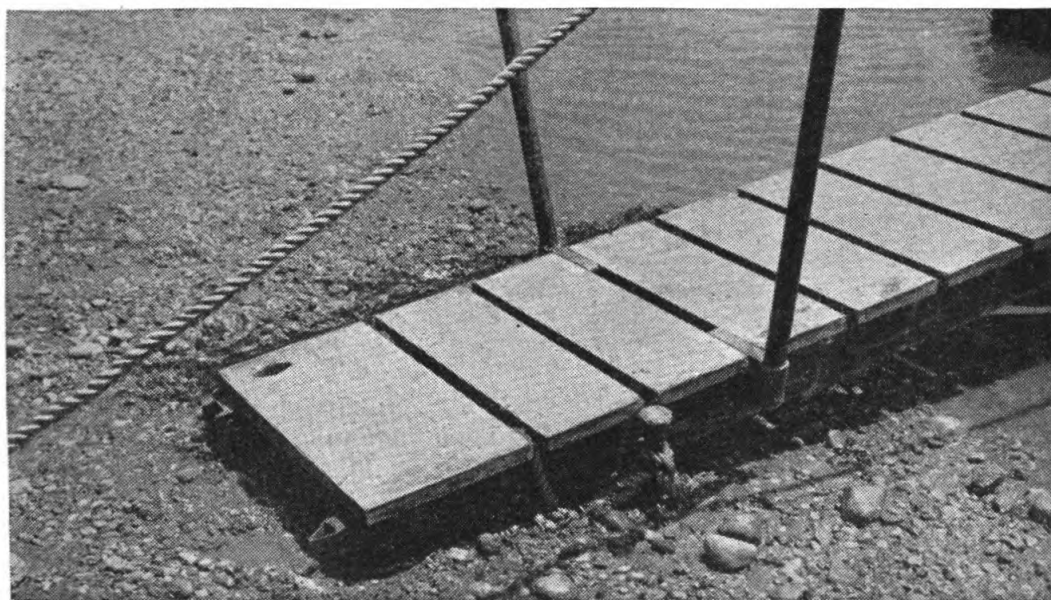


FIGURE 48.—Duckboard fastened to shore.

from the bridge. After the float cable has been removed, care must be exercised not to overload the bridge.

68. Reinforced bridge.—*a. Assembly of bays.*—The reinforced bridge bay consists of three duckboards, six floats, and two hand-

rail posts. (See fig. 50.) From one unit of bridge 144 feet of reinforced bridge can be constructed.

b. Anchorage.—Anchor cables and float cables are required with the reinforced bridge when the bridge is carrying maximum loads because of increased float resistance to the current.

c. Construction.—Anchor cable, bridle line, handrail line, and river assembly sections of the same size as for the normal bridge are required. Two or more shore assembly details are required, each to consist of one noncommissioned officer and ten men. The assembly-carrying detail is increased to one noncommissioned officer and twelve men. With at least two shore assembly details working, the reinforced bridge can be constructed in about twice the time required for the same length of footbridge.

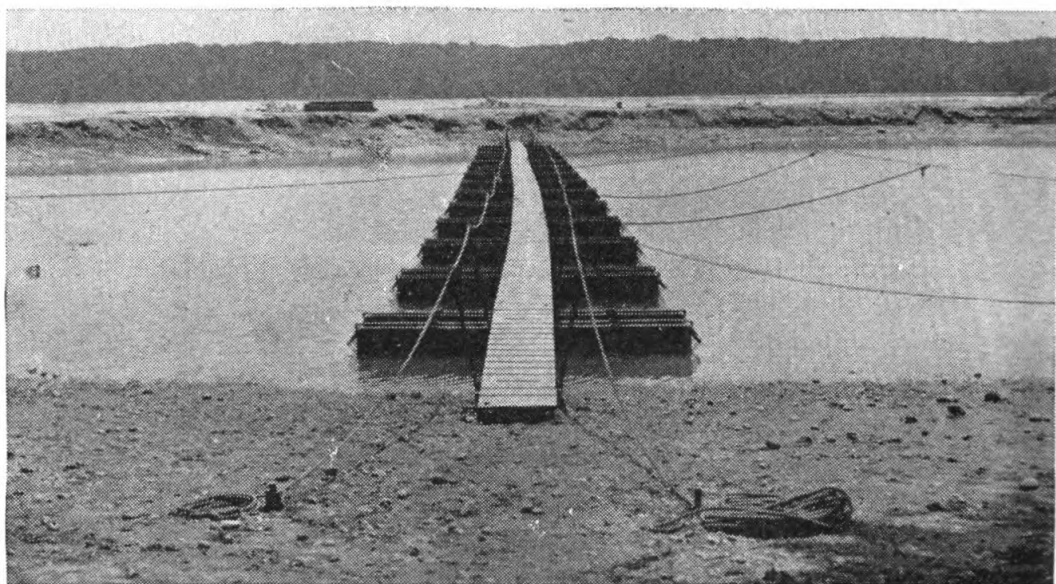


FIGURE 49.—Footbridge ready for use.

d. Capacity.—Reinforced bridge will carry—

- (1) 37-mm antitank guns towed by hand.
- (2) Foot troops in column of threes at a walk, at rate of 100 men per minute.
- (3) Foot troops in column of twos at a run, at rate of 150 men per minute.
- (4) Horses may be crossed with wide intervals when float cables are used. Motorcycles with sidecars may also cross.

69. Ferrying.—Rafts of one bay are virtually useless as ferries because of their limited capacity and the extreme difficulty of controlling or propelling them even in still water. Rafts made of one bay of reinforced bridge, or of two bays with floats dovetailed and lashed together, may be of some utility in ferrying operations, but

even such units are poorly adapted to the purpose. These rafts must be guided and moved by means of cables or ropes; without these aids they are unmanageable.

70. Care and maintenance of equipage.—*a. General.*—All parts of bridge equipage should be carefully inspected at frequent intervals. Damaged or broken parts should be repaired or replaced, and all parts cleaned, painted, and greased as required. A well-ventilated shed or building should be used for storing equipment. Floats and duckboards should be kept from contact with ground and

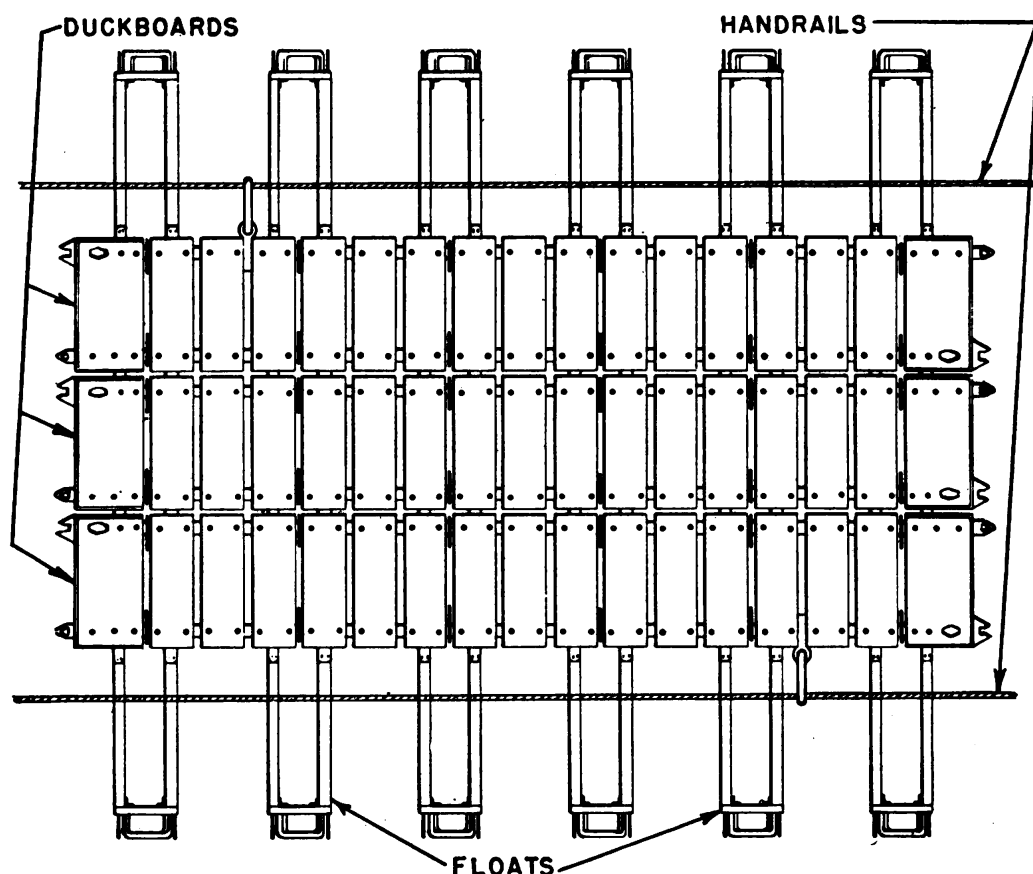


FIGURE 50.—Assembled bay of reinforced bridge.

piled so as to permit ventilation through the stacks. Standard olive-drab paint is suitable for painting parts of equipment requiring paint.

b. Duckboards.—In disassembling the bridge the duckboard fasteners and wooden parts should be handled carefully. There is much less danger of damage in the dismantling operation if each bay is removed from the bridge while it is still afloat. In disconnecting bays from remainder of the bridge, the lug on end of handrail post should be used only as a key to separate the spring leaves by turning post about its axis through an angle of 90° . When the joint does not

disengage easily, separation should be accomplished by jiggling and working the parts rather than by attempting to force them apart. An effort to pry the bridge apart with the handrail posts results only in damage to both floor boards and handrail posts.

c. Floats.—Excessive heat or oil damages the rubber blocks used in floats. Therefore, the floats should not be stored indoors next to stoves, radiators, or steam pipes, nor outdoors in the sun. The surfaces of the rubber blocks become brittle in time. Tears and abrasions of the surface accelerate deterioration of the material. The fasteners which connect floats to duckboards should be secured by the



FIGURE 51.—Typical loading of 2½-ton truck.

spring clips provided. These fasteners should be kept clean and should be washed, dried, and oiled before the floats are placed in storage.

d. Handrail posts.—The handrail posts are not designed for use as crowbars and must not be used as such.

e. Rope.—Rope should be kept dry and clean and should be carefully washed, dried, and coiled before storing. The harness snaps on the anchor lines also should be cleaned, dried, and oiled before storing.

f. Cables.—Particular care should be taken to avoid kinking cables. When securing the ends of a cable to holdfasts, a suitable loop should be formed and secured with the cable clips provided (see par. 48f).

Knots should not be used in fastening either end. Formation of loops except near an end of the cable should be avoided.

71. Transportation.—*a. Four 1½-ton trucks.*—The standard load for a 1½-ton truck is 108 feet of bridge. Four 1½-ton trucks are required to carry one unit of the bridge.

b. Three 2½-ton trucks.—The standard load for 2½-ton truck is 144 feet of bridge. Three 2½-ton trucks are required to carry one unit of the bridge. (See fig. 51.)

CHAPTER 5

RECONNAISSANCE BOAT AND 6-TON FLOAT,
PNEUMATIC

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SECTION I

GENERAL

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72. Purpose.—Pneumatic reconnaissance boats and 6-ton pneumatic floats are issued to engineer units to supplement other types of river-crossing equipage, to facilitate reconnaissance, and to cross small parties over unfordable streams.

73. Features of design.—This equipment is made of rubberized fabric. The boats and floats are light in weight and easily portable.

SECTION II

RECONNAISSANCE BOAT

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Methods of employment-----	76
Storage and repair-----	77

74. Description.—The pneumatic reconnaissance boat (fig. 52) is 9 feet 6 inches long by 5 feet wide. It tapers to a point at the bow and tapers slightly to a blunt end at the stern. It is formed of rubberized fabric tubing, 16 inches in diameter, which is divided by bulkheads into four compartments. The boat has a flooring of rubberized fabric. A life line extends around the outside. There are two inflatable seats, 20 inches long, 10 inches wide, and 6 inches deep. Inside the boat is a pocket which contains an emergency repair kit and two small hand pumps. The boat weighs approximately 55 pounds and has a maximum displacement of 1,600 pounds. It will carry six men (fig. 53②). Three paddles are issued with each boat. Deflated, the boat is folded and packed into a carrying case 3 feet long and 18 inches in diameter.

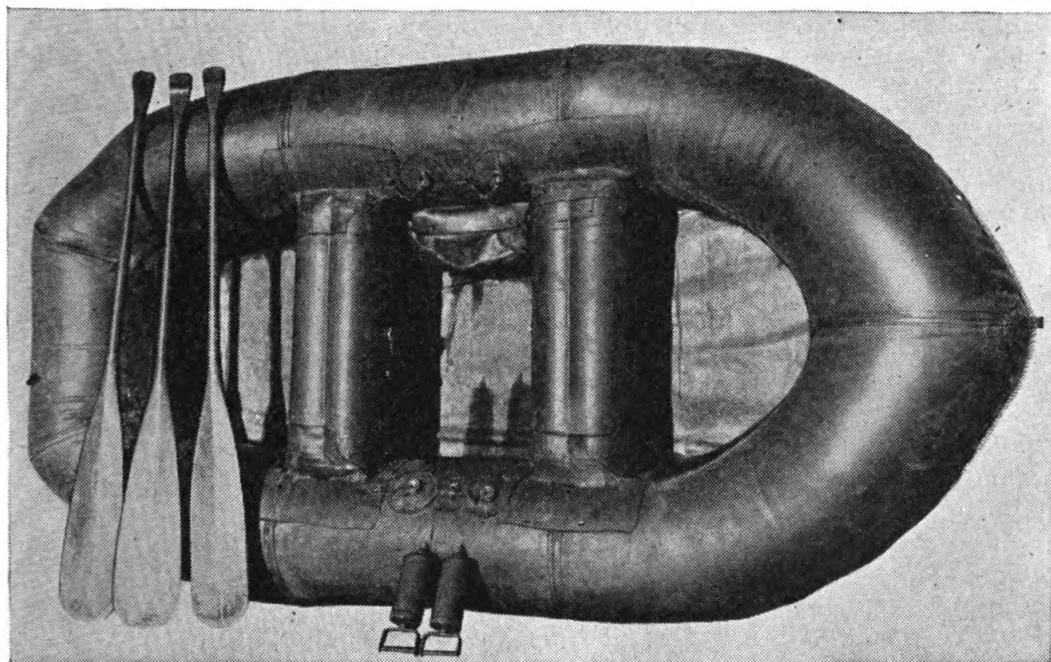


FIGURE 52.—Pneumatic reconnaissance boat.

75. Inflation and deflation.—Hand pumps are used to inflate the reconnaissance boat. Inflation by an air compressor is not recommended. The boat can be inflated in 10 minutes by use of two hand pumps. In an emergency the boat can be inflated by mouth. Air pressure should be sufficient to round out the air chambers. Air chambers should be firm but not hard and should yield to pressure applied by the heel of the hand.

76. Methods of employment.—The pneumatic boat is used primarily for reconnaissance work (fig. 53①). Inflated it can be carried by two men. It may be used to supplement assault boats in second and later waves of river crossings (fig. 53②).

77. Storage and repair.—The directions in paragraph 82 for the 6-ton float also apply to the pneumatic reconnaissance boat. The emergency repair kit issued with the reconnaissance boat is similar to that issued with the 6-ton float.

SECTION III

SIX-TON FLOAT

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78. Description.—*a.* The 6-ton pneumatic float (figs. 54 and 55) is 20 feet long, 6 feet wide, and 2 feet deep. It is made of rubberized

fabric and consists of an outer tube, a floor, and a removable central tube. Each tube is 24 inches in diameter.



① Carrying three men on reconnaissance.



② Carrying six men in river crossing.

FIGURE 53.—Employment of pneumatic reconnaissance boat.

(1) The outer tube is divided by bulkheads into eight compartments, each with a separate inflation valve. Straps on the outer tube are used to secure a superstructure to the float when constructing expedient rafts or bridging.

(2) The removable central tube is divided into two compartments. Tie-down straps hold it in place. This central tube increases the rigidity of the float and maintains buoyancy when the float is submerged. It is normally removed when the float is used as a personnel carrier.

(3) A life line extends around the outside of the float; it is *not* used for carrying. D-rings are attached to the float for carrying and lashing purposes.

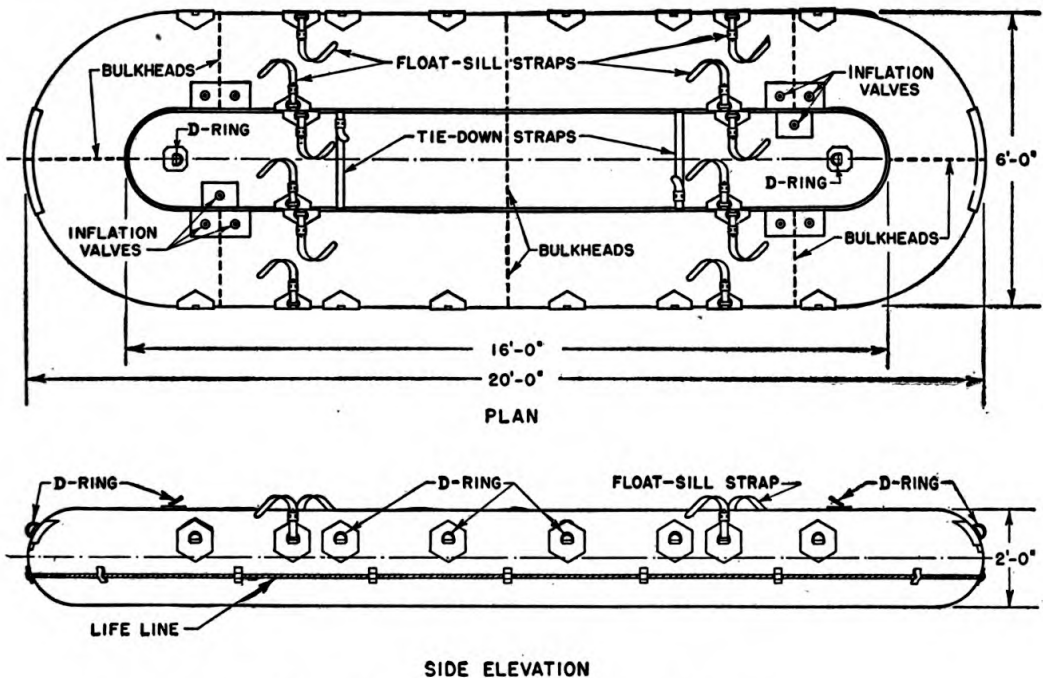


FIGURE 54.—Plan and elevation of 6-ton float.

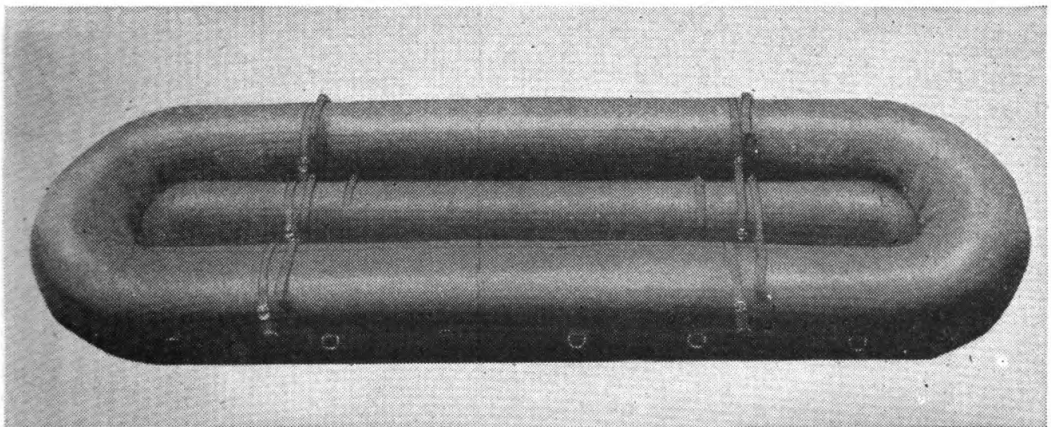


FIGURE 55.—Six-ton pneumatic float.

b. The float weighs approximately 375 pounds and has a maximum displacement of 12,000 pounds. It is carried folded in a canvas case 3 feet square by 18 inches deep. Included in each case is an emer-

gency repair kit. Seven paddles in a canvas case are issued with each float.

79. Inflation and deflation.—*a.* Pneumatic floats must be inflated with care. The air used should be free of oil. The float may be inflated in approximately 3 minutes by using a four-hose inflation-deflation manifold with the standard air compressor.

b. The working pressure in the float should not exceed $11\frac{1}{2}$ pounds per square inch; at this pressure the air chambers are firm but not hard and yield to pressure applied by the heel of the hand. Additional pressure adds nothing to buoyancy and will damage the float. Changes in temperature should be anticipated. Floats inflated to proper pressure will become overinflated if air is not released as the temperature rises. Air must be added as the temperature drops. Air pressures should be checked regularly.

c. Floats are deflated by removing valve caps and allowing air to escape. The remaining air should be drawn out with the inflation-deflation manifold to make the float easier to pack in a small space.

80. Carrying float.—Inflated floats should be carried, not dragged, as dragging tears the fabric.

81. Methods of employment.—*a. Personnel carrier.*—The float may be employed either as a reconnaissance boat or as an assault boat in a river crossing (fig. 56). As an assault boat, it should not be used in the first wave as it is too vulnerable to small-arms fire. When the float is used to carry personnel or equipment, the central tube is removed. It is advisable to lay planks on the flooring to prevent puncturing the fabric. The float will accommodate 15 men



FIGURE 56.—Six-ton pneumatic float employed as an assault boat.

comfortably; the maximum number that can be crowded on is 30. The men straddle the outer tube and propel the float with paddles. If enough paddles are available, as many as 15 may be used to propel the boat.

b. Expedient rafts.—(1) Rafts may be assembled of pneumatic floats and extra plywood treadways, siderails, and siderail clamps from infantry support raft equipment (see ch. 3). Siderails, used as float sills, are laid along the outer tubes of the floats and are strapped in place. The treadways are laid across the float sills and lashed to the D-rings on the sides of the floats. Siderails are clamped in place on the inside edges of the treadways. A raft made up of three pneumatic floats and six plywood treadways has a capacity of approximately 10 tons.

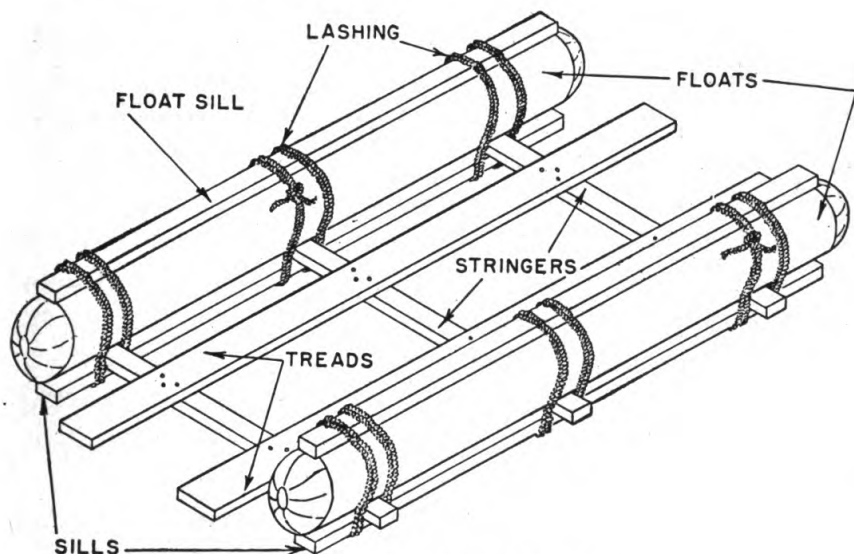


FIGURE 57.—Expedient raft.

(2) If standard equipment is not available, superstructure may be improvised from local materials. Planks may be used as float sills; timbers, 4 by 6 inches or larger, telephone poles, or logs may be used as stringers; and planks at least 2 inches thick will serve as flooring. Lashings are used to tie parts of the superstructure together and to hold it in place on the floats.

(3) An expedient raft can be constructed with central tubes from the floats and chess or similar planks. (See fig. 57.)

82. Storage and repair.—*a. Storage.*—Because heat and sunlight cause deterioration of rubber, pneumatic floats should be stored in a dry, cool, dark place. They should be kept thoroughly cleaned and dried before storing and should be kept off the ground on planks to prevent mildew. When floats are stored on a beach, they should be stacked upside down, to prevent their becoming filled with water.

When they are stored deflated, all valve caps should be on tight to keep out moisture.

b. Repair.—(1) *Emergency repair kit.*—Packed in each float-carrying case is an emergency repair kit containing pieces of rubberized fabric, a metal scratcher, a bottle of rubber cement, valve caps and washers, a hand roller, a pair of scissors, and wooden plugs.

(2) *Repair of floats.*—(a) *Cement repairs.*—Small leaks can be located by inflating the float and covering the outside with thick soap suds. After the leak is located the surface around the hole is roughened lightly with the scratcher, and washed with benzine, naphtha, or clear gasoline, and allowed to dry. At least two coats of heavy cement (three parts of cement to one part of benzine or gasoline) are applied to the area. While this is drying, a piece of rubberized fabric is cut to size and prepared in the same manner. The patch is then applied over the hole and rolled or pressed down firmly. To repair large tears, it is necessary first to prepare the inside surface and to place a patch inside of the tube; where necessary, the hole may be enlarged to permit this. After the inside patch has been placed and allowed to dry an outside patch is applied as previously described.

(b) *Repair with wooden plugs.*—Temporary repair of small leaks can be made by using the wooden plugs in the repair kit. They are inserted into the hole and twisted tight.

(c) For a more detailed discussion of float repairs, see TM 5-275, *Pneumatic Ponton Bridge, M3* (when printed).

CHAPTER 6

FERRY SET

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83. General.—*a.* The ferry set consists mainly of rope, snatch blocks, and holdfasts for use with rafts and other floating equipage in the construction of cable ferries. The equipment in the ferry set is listed in table II.

b. The infantry support raft is described in chapter 3. Construction of rafts from ponton equipage is described in TM 5-273. Any raft, large boat, or barge can be used as a ferryboat.

84. Trail ferry.—The trail ferry principle may be used to propel a ferryboat where the current exceeds 2 miles per hour. (See fig. 58.)

a. A cable is stretched across the stream and made fast to suitable trees or holdfasts. If holdfasts are used, the cable may be elevated by passing it over an A-frame erected on each bank. Ratchet chain hoists are used to take excess sag out of the cable from time to time as it stretches. A snatch block is attached so that the sheave is free to roll on the cable. Maneuvering lines are run from the hook of the snatch block to the upstream portions of the raft.

b. The trail ferry is operated as follows: By means of the maneuvering lines running from the floats to the block, the raft is turned at an angle to the current so that the upstream ends of the raft floats incline toward the shore to which it is desired to move the raft. The current pushes against the upstream sides of the floats and forces the raft to move across the stream, the snatch block traveling on the cable. Speed of the raft increases as its floats are pointed out of the current up to about 45°.

85. Flying ferry.—The flying ferry works on the same principle as the trail ferry, except that the raft is held in the stream by means of an anchor cable fastened well upstream from the crossing site. (See fig. 59). If the strongest current is near one shore, the anchorage must be located near the opposite shore; if the current is uniform, the anchorage should be located in midstream. The length of the cable must be at least one and one-half times the width of the stream. The cable is supported at intervals by floats to keep it out of the water. The cable is made fast to the raft at its center, and maneuvering ropes for turning the raft toward one shore or the other are made fast to the cable. As the raft moves from shore to shore, it

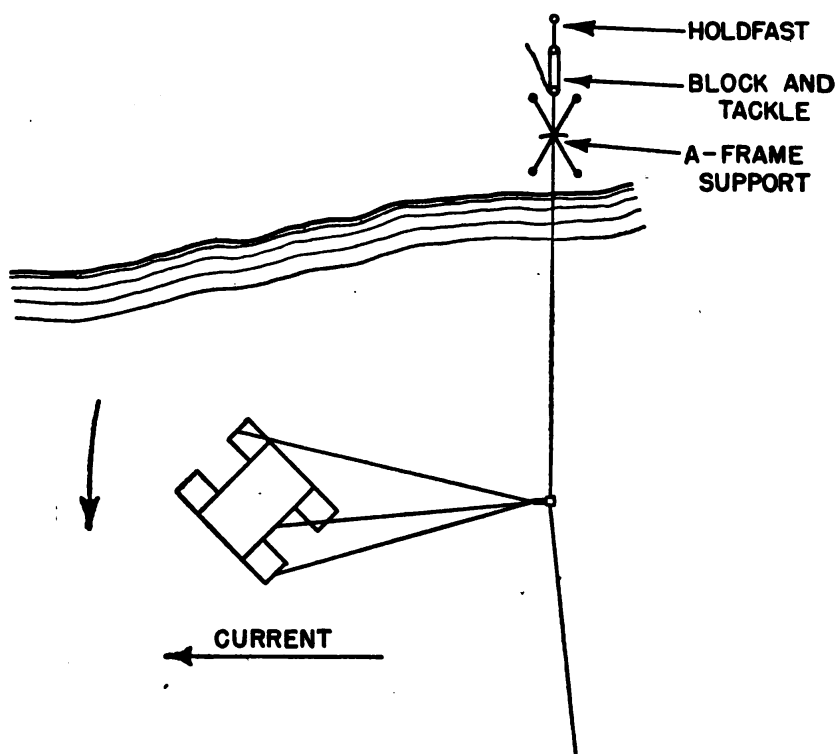


FIGURE 58.—Lay-out for trail ferry.

swings in the arc of a circle, the center of which is the anchor. The flying ferry requires a current velocity of at least $2\frac{1}{2}$ miles per hour throughout its path of travel.

86. Other means of propulsion.—The outboard motor may be used in conjunction with the trail ferry or flying ferry to add speed and to provide against drifting downstream. Two or more rafts may use the same cable ferry site, the number to be used depending upon the ratio of crossing time to the loading or unloading time. Outboard motors may also be used alone, if the current is not sufficient for self-

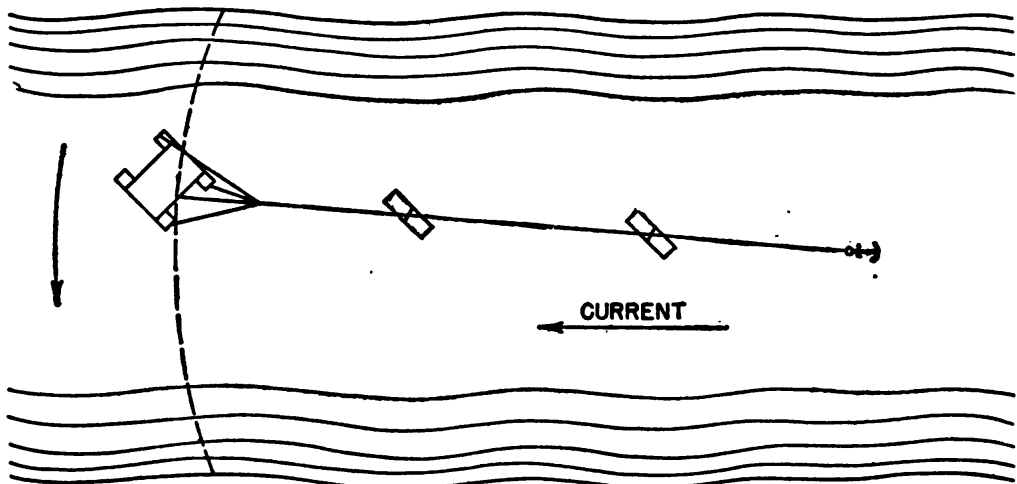


FIGURE 59.—Lay-out for flying ferry.

propelled ferries. Another satisfactory arrangement when there is little current is to pull the ferry by means of ropes.

87. Landing stages.—Landing stages are not required for the infantry support raft equipage but are used for the 10-ton or 25-ton ponton equipage.

88. Basis of issue.—Ferry sets are part of the organizational equipment of the following engineer units and are issued in the quantities given: two to each engineer combat battalion, engineer squadron, and light ponton company; and four to each heavy ponton battalion. One additional ferry set is a part of each unit of light and heavy ponton bridge.

89. Transportation.—Ferry sets are carried on vehicles assigned to transport the infantry support rafts.

TABLE II.—*Ferry set*

Equipment	Basic quantity	Spares	Total
Block, snatch, $\frac{1}{8}$ -inch, manila rope.....	3	1	4
Chest, ferry set, wooden.....	1	0	1
Clip, cable, $\frac{1}{2}$ -inch.....	12	12	24
Grip, cable, $\frac{1}{2}$ -inch, wire rope.....	2	1	3
Holdfast, with nine steel pickets.....	4	0	4
Hoist, chain, ratchet, $1\frac{1}{2}$ - and 3-ton capacity.....	1	0	1
Rope, wire, $\frac{1}{2}$ -inch, 6 x 19 galvanized plow steel (on 600-foot spools).....	600	0	600
Rope, manila, $\frac{1}{2}$ -inch, feet.....	600	0	600
Wrench, crescent, 10-inch by $1\frac{1}{2}$ -inch.....	2	1	3

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[A. G. 062.11 (1-25-43).]

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(For explanation of symbols see FM 21-6.)

